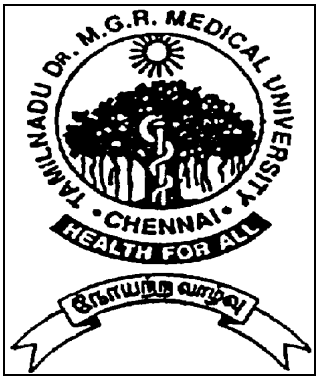
DIAGNOSTIC UTILITY OF VARIOUS TECHNIQUES IN BONE TUMOURS

Dissertation submitted in partial fulfillment of the requirements for the degree of

M.D. (Pathology) – Branch III



THE TAMILNADU DR.M.G.R.MEDICAL UNIVERSITY
CHENNAI

MARCH 2007

CERTIFICATE

This is to certify that this dissertation entitled **"DIAGNOSTIC UTILITY OF VARIOUS TECHNIQUES IN BONE TUMOURS"** is a bonafide work done by **Dr.M.GUNA SUNDARI**, in partial fulfillment of the requirements of The TAMIL NADU DR.M.G.R. MEDICAL UNIVERSITY, Chennai for the award of M.D. Pathology Degree.

DIRECTOR

Prof. Dr.A.V.SHANTI, M.D.,
Director and Head
Institute of Pathology
Madras Medical College,
Chennai – 600 003.

GUIDE

Prof. Dr.HEMA LATHA GANAPATHY, M.D.,
Additional Professor of Pathology,
Institute of Pathology
Madras Medical College,
Chennai – 600 003.

DEAN

Prof.Dr.KALAVATHY PONNIRAIVAN, B.Sc., M.D.,
Dean
Madras Medical College &,
Government General Hospital,
Chennai – 600 003.

DECLARATION

I declare that this dissertation entitled **"DIAGNOSTIC UTILITY OF VARIOUS TECHNIQUES IN BONE TUMOURS"** has been done by me under the guidance and supervision of **Prof. Dr.HEMA LATHA GANAPATHY, M.D.,** It is submitted in partial fulfillment of the requirements for the award of the M.D., Pathology degree by The Tamilnadu Dr.M.G.R. Medical University, Chennai. This has not been submitted by me for the award of any degree or diploma from any other University.

Dr.M. GUNA SUNDARI

ACKNOWLEDGEMENT

My thanks are due to the Dean **Dr.KALAVATHY PONNIRAIVAN, B.Sc, M.D.,** Madras Medical College and Government General Hospital for permitting me to use the college facilities for my dissertation.

It is both a pleasure and honour for me to have been a student of **Dr.A.V.SHANTI, M.D.,** Director and Head of Department, Institute of Pathology, Madras Medical College. She has been a constant source of inspiration and encouragement in all my endeavours.

I wish to acknowledge the immense help and guidance of **Dr.HEMA LATHA GANAPATHY, M.D.,** Additional Professor of Pathology, at every step of my study.

I am thankful to the Additional Professors, Assistant Professors and my fellow post graduates for their helpful suggestions in carrying out this work.

I am extremely thankful to Professor and Head of the Department of Orthopoedics surgery and Assistant professors for providing materials for my study.

I am greatly indebted to my patients without whom the study would not have been possible.

Finally, I thank god for making all these wonderful people happen to me.

Dr. M. GUNASUNDARI

CONTENTS

INTRODUCTION

Bone tumours are relatively uncommon. The precise incidence of specific bone tumours is not known, because many bone lesions are asymptomatic and are not biopsied.

In 1958, Jaffe pointed out the importance of correlation between the surgeon, the radiologist and the pathologist in diagnosis of bone lesions [1].

Tumours of the skeletal system are relatively constant in their presentation. The five basic parameters of importance in this regard are the age of the patient, bone involved, specific area with in the bone (epiphysis, metaphysis (or) diaphysis, cortex, medulla or periosteum), radiographic appearance and microscopic appearance. The pathologist should be fully aware of the first four before trying to evaluate the fifth.

Symptoms are most often non specific in bone tumours. Most patients present with pain, swelling or both. Occasionally the patient present with pathological fractures. None of these features suggest a specific diagnosis. However there are some lesions of bone associated with specific symptomatology. A patient with an osteoid osteoma can presents with exquisite pain which is relieved with analgesic. A patient with Ewings sarcoma of bone may present with fever and increased ESR suggesting the diagnosis of osteomyelitis. This may lead to inappropriate therapy and delay in diagnosis. So symptoms are of limited value in arriving at a diagnosis.

The age of the patient and the exact location of the tumours are extremely important. Most of the highly malignant sarcomas such as Ewings sarcoma and osteosarcoma occur in children. Lower grade sarcomas such as chondrosarcoma occur in adults.

The location and extent of the lesion are of great importance. Giant cell tumour usually occur at the epiphyseal end of the bones.

A lesion containing a large number of giant cells occurring in a location such as metaphysis (or) diaphysis should suggest the possibility of some other process – such as hyperparathyroidism, osteosarcoma (or) Aneurysmal bony cyst.

About half of the osteosarcoma arise around the knee either in the distal femoral (or) proximal tibial metaphysis. A cartilaginous neoplasm involving the flat bone is a chondrosarcoma.

Roentgenographic appearance is of great importance. The roentgenogram is the best way to localize the lesion. There are several radiological features that aid in diagnosing a benign from malignant lesion. Benign tumours tends to be well circumscribed and may have a sclerotic rim. Malignant tumours tend to be poorly circumscribed. Most spindle cell sarcomas tend to show geographic areas of destruction. Geographic destruction refers to a large hole in the bone. Small cell malignancies such as Ewings sarcoma tends to show permeative destructive process, this refers to a moth eaten appearance in which there are multiple small holes in the bone with intervening residual bone [1].

The character of the periosteal reaction is important. Benign lesions such as Langerhan cell histiocytosis show thick, regular periosteal new bone formation. Malignant tumours such as Ewings sarcoma tends to form multiple layers of poorly organized new bone in the periosteum.

Existing estimates suggest however, that benign tumours are more frequent in males. Data concerning bone sarcoma are more comprehensive and reveal that males and females are affected at a ratio of 1 : 0.7.

Although primary tumours develop in all parts of the skeleton, most demonstrate a predilection for the long tubular bones. Benign tumours tend to arise in the appendicular skeleton, with approximately 45% developing in the femur and tibia, usually about the knee. In comparison to benign tumours, bone sarcomas more frequently involve the pelvis and axial skeleton and rarely affect the small bones of hands and feet.

AIMS OF THE STUDY

1. To assess the diagnostic accuracy of fine needle aspirates of bone. The analysis compared the accuracy according to anatomical location, size type of lesion and histology.

2. To assess the diagnostic accuracy of core needle biopsy

3. To compare the diagnostic accuracy of Fine Needle aspiration and core needle biopsy

4. Comparative evaluation of other authors data with our study

REVIEW OF LITERATURE

Neoplasms and tumour like conditions of bone are rare. Bone tumours tend to affect young children and adolescents. These factors are a cause of concern for the surgical pathologist dealing with a bone tumour because a diagnosis of sarcoma will result in extensive surgery and, in most cases, chemotherapy with or without radiotherapy. Historically, the diagnosis of a sarcoma often mandated amputation surgery and carried a poor prognosis.

The key to their accurate recognition is the utilization of an integrated approach that assesses and correlate the clinical, radiographic, morphologic and biologic behaviour of these lesions.

The first systematic classification of the tumours primary in bones was that proposed by the registry of bone sarcoma of the American College of Surgeons – in 1920. Ewing published an official revision of the Registry's classification. This revision has undergone further modifications by others, but still constitutes the care of the many of the later versions.

Etiology :

Chromosomal mutations in mesenchymal stem cells are responsible for neoplastic transformation, proliferation and ultimately, bone tumour formation. Genetic mutations specific to particular bone tumour type are infrequently identified. Benign and malignant bone tumours are, however, components of a variety of genetic syndromes including olliers disease, Maffuci syndrome, multiple hereditary osteochondromas, bilateral retinoblastoma, Li – Fraumeni

syndrome, Gardner syndrome, Mazabraud syndrome, McCune – Albright syndrome. Neurofibromatosis and diaphyseal medullary stenosis.

A variety of disease create conditions within bone that facilitate the development of neoplasms, especially sarcomas. The most important of those are Paget's disease, radiation injury, bone infarction and chronic osteomyelitis.

Pre exisiting bone tumours undergo malignant transformation infrequently and those that do so are most commonly enchordroma and osteochondroma; rarely does it occur with fibrous dysplasia or a simple bone cyst.

Recently, reports have documented the development of sarcomas adjacent to orthopedic implants. The incidence of this dreaded complication appears, however to be exceedingly small, and the carcinogenic properties of the chemical components of the implants in humans are thought to be minimal[2].

Classification of bone tumours :

The classification that is used more or less universally is the one first proposed by Lichtenstein. Most bone tumours are classified according to the normal cell and tissue type they recapitulate.

The terminology and classification of bone tumours are recommended by the WHO international reference centre for the histological definition and the classification of bone tumours. In WHO classification, most neoplasm are classified as either benign (or) malignant. Some neoplasms exhibit borderline (or) intermediate characteristics, such as GCT and well differentiated

cartilaginous tumours. Most malignant bone tumours arise de novo, but there is a small number of benign bone lesions that predispose the patient to the development of skeletal malignancies. These include pagets disease, chondromatosis, osteochondromatosis, fibrous displasia and osteofibrous dysplasia[3].

Classification of primary tumours of the bone.

Histological type	Benign	Malignant
Hematopoietic (40%)		Myeloma Malignant lymphoma
Chondrogenic (22%)	Osteochondroma Chondroma Chondroblastoma Chondromyxoid fibroma	Chondro sarcoma Clear cell chondro sarcoma Myxoid chondro sarcoma Dedifferentiated Chondro sarcoma Mesenchymal chondro sarcoma
Osteogenic (19%)	Osteoid osteoma Osteoblastoma	Osteosarcoma
Unknown origin	Giant cell tumour	Ewings tumour

(10%)		Giant cell tumour Adamantinoma
Histiocytic origin	Fibrous histiocytoma	Malignant fibrous histiocytoma
Fibrogenic	Metaphyseal fibrous defect (fibroma)	Desmoplastic fibroma Fibro sarcoma
Notochordal		Chordoma
Vascular	Heamangioma	Hemngio Endothelioma Hemangio pericytoma
Neurogenic	Neurilemmoma	

Sub classification of osteosarcoma :-

Osteosarcoma within bone :-

Conventional Osteosarcoma	**Surface osteosarcoma**
- Osteoblastic	Parosteal osteosarcoma
- Chondroblastic	Periosteal osteosarcoma
- Fibroblastic	High grade osteosarcoma

- Small cell
- Telengiectactic
- Low grade central
- Osteosarcoma in pagets disease
- Post irradiation osteosarcoma
- Osteosarcoma in other benign precursors

Among the bone tumours, osteosarcoma and the fibrous cortical defect are the most frequent. Excluding malignant neoplasm of the marrow origin, (myeloma, lymphoma and leukemia) osteosarcoma is the most common primary cancer of bone followed by chondrosarcoma and Ewings sarcoma[4].

Metastatic tumours of the bone [4]

Are the most common form of skeletal malignancy. Any cancer can spread to bone.

The pathways of spread include

1. Direct extension
2. Lymphatic (or) vascular dissemination and
3. Intraspinal seeding (Batson plexus of veins)

In adults, more than 75% of skeletal metastasis originate from cancer of the prostate, breast, kidney and lung.

Soft tissue sarcomas rarely metastasize to the skeletal system, the outstanding exception being Embryonal Rhabdo Myo Sarcoma (RMS) of the soft tissue in children. In children metastases to bone originate from neuroblastoma. Wilms tumour, osteosarcoma, Ewings sarcoma and RMS. In all bones, metastases are preferentially situated in red bone marrow.

Skeletal metastases are typically multifocal; however, carcinoma of kidney and thyroid are notorious for producing solitary lesions.

The metastases may occur in any bone, but most involve the axial skeleton (vertebral, pelvis, ribs, skull, sternum and humerus in descending order of frequency. Metastases to the small bone of the hands and feet are uncommon and usually originate in cancers of lung, kidney (or) colon.

The radiological manifestation of metastases may be purely lytic, purely blastic (or) mixed lytic and blastic. In lytic lesions, the metastatic cells secrete substances such as prostoglandins, ILs and parathyroid hormones – related protein that stimulate the osteoclastic bone resorption, the tumour cells themselves do not directly resorb bone. Carcinoma of lung, kidney, GIT and melanoma produce this type of bone destruction.

Metastases that elicit a sclerotic response particularly prostatic adenocarcinoma do so by stimulating osteoblastic bone formation. Most metastases induce a mixed lytic and blastic reaction.

The bones involved and the character of the changes seen radiographically are helpful in predicting the site of the primary neoplasm.

Thyroid carcinoma usually metastasizes to the bones of the shoulder girdle, skull, ribs, sternum, flat bone of pelvis, femur and scapula. Exuberant new bone formation can also occur, because of the pathological fracture associated with metastatic carcinoma. Any tumor metastatic to bone may lead to hypercalcemia and elevation of serum acid phosphatase[4].

PRINCIPLES OF BONE TUMOUR DIAGNOSIS

The diagnosis of bone tumours has always been difficult in part because of their absolute rarity (< 1% of all malignant neoplasms).

Proper and accurate diagnosis of bone tumours require multidisciplinary involvement.

Diagnosis of bone lesion should be approached from a dynamic stand point with the pathologist working in close colobration with the radiologist and orthopedic surgeon.

Radiological diagnosis :

Radiology is of great importance in the diagnosis of bone tumors. Radiograph should always be available to the pathologist, who should never make a definite diagnosis without knowing the radiological features.

The following points should be ascertained from a radiographic examination of a bone lesion[5].

1. Type of bone affected (Tubular (or) flat)
2. Sit of lesion – Epiphysis, metaphysis, diaphysis, growth plate

    - medullary, cortical (or)

      Juxta Cortical location

3. Total length and circumference of the bone affected
4. Nature of any bone changes present – destructive, proliferative, moth eaten, permeative (or) geographic
5. Character of the margin of the lesion (sharp, ill defined)
6. Character of the periosteal reaction (laminated, onion peal, sun burst solid, codmans triangle)

Combining clinical and radiographic information helps the pathologist provide a more accurate and definite diagnosis[5].

Radiological features favouring benign versus malignant lesions

S.No.	**Benign**	**Malignant**
1.	Geographic destruction	Moth eaten and permeative destruction
2.	Occasionally moth eaten	Rarely Geographic
3.	Non aggressive rim of bone sclerosis	Absence of non aggressive bone sclerosis
4.	Periosteal reaction uncommon if present – usually smooth, solid uninterrupted	Periosteal reaction common and often interrupted spiculatd and lamellated
5.	Absence of soft tissue extension	Soft tissue extension common

Fine Needle Aspiration of bone tumours :

Aspiration cytology of bone tumours was introduced in 1930s. Needle biopsy is a rapid effective and safe method of evaluating unsuspected lesion of bone[6].

The use of needle aspiration biopsy in the diagnosis of skeletal lesions was first introduced by Coplay et al in 1931 and later by Martin and Ellis in 1934[7].

Synder and Coley reported in 1945 their experience with needle biopsy in bone tumor with an accuracy of 72% in primary lesion. Vertebral biopsies were first reported by Robertson and ball in 1932[7].

Encouraging results obtained by Bhatia and Sharma (1984) have prompted the adoption of the procedure as major pre operative diagnostic tool.

FNAC of bone performed at the university of Texas MD Anderson hospital during the period January 1978 to December 1986 were reviewed[6]. FNA is a powerful tool in the multi disciplinary approach to the diagnosis and management of osteosarcoma. The two important limitation of technique are that densely osteoblastic tumours often yield poorly cellular aspirate and osteiod cannot be identified confidently on cytological smear. Inspite of these limitations, FNA is an extremely useful procedure in the current diagnosis and management of bone tumours. The most significant limitation of FNA is the inability to detect osteoid[6].

FNA is an excellent for confirming the diagnosis of metastatic malignancy. It is not good for diagnosing primary tumours. It is possible to diagnose a malignancy in cases of osteosarcoma. But it is not possible to subclassify the type of osteosarcoma on the basis of material obtained in FNA[1]. FNA are inappropriate for the diagnosis of cartilaginous tumours. FNA are less useful to diagnose benign neoplasm. However cytological material should be interpreted with the full knowledge of the clinical and radiologic features of the lesions[1].

Most cytopathologist define FNAC as the use of 22 guage needle, the risk of needle tract seedling is exceedingly low and appears to be between 0.003% and 0.009%. among bone tumours, false +ve rate range from < 1% - 5% and false negative rates ranges from approximately 2% - 15%[5].

Although the value of FNAC in distinguishing malignancy from benignancy approaches and exceeds 90%, its accuracy for establishing a specific histologic subtype has been for less tested[5].

ANDRIS KREILBERGS and Colleagues evaluate the diagnostic accuracy of FNAC in a prospective study of 300 patients with previously undiagnosed bone lesions. FNAC was performed under radiological control as an OP procedure. The diagnosis was correct in 239 (95%) cases providing adequate cytological material. There were 8 (3%) falsely malignant. Chondrosarcoma gave the greatest diagnostic difficulty and Ewings sarcoma the least. This study suggest that FNAC is a valid option for the diagnosis of

bone tumours. It is a simple out patient procedure which gives sufficient cytological material for the correct diagnosis in 80% of cases. The cytological assessment must agree with the clinical and radiological findings[8].

Elkhoury et al (1983) noted that the predictive value of a positive results is 100% and therefore a positive diagnosis can be considered definitive. Further biopsy then is unnecessary. After a negative result one may repeat the aspiration (or) proceed with an open biopsy[9].

Hajdu and Melamed (1984) have emphasized the basic limitation of the technique. The histological architecture is lost in aspiration samples. The drawback was overcome by processing the blood clot separately. This was studied by Hewes, Vigorita and Freiberger (1983). The osseous blood was considered better diagnostic material even, when compared to bone core. These authours stress that the osseous blood should be treated as a tissue specimen and not discarded[9].

Tumours that are predominantly sclerotic may not be adequately sampled especially with FNAC. Bone tumours usually not amenable to needle biopsy include the following

Osteoma	Enchondroma
Osteoid osteoma	Low grade chondro sarcoma
Osteoblastoma	Metaphyseal fibrous defect

Low grade osteosarcoma	Fibrous dysplasia
	Osteofibrous dysplasia
	Hemangioma

Core needle biopsy : CNB

Is a rapid, effective and safe method of evaluating unsuspected primary lesion of bone. The accuracy rate of procedure was 93%[5].

It generally involves obtaining cores of tissue using a 14 guage (or) 18 guage needle. Vertebral biopsies were first reported by Robertson and Ball in 1932[10].

Indications for CNB:

1. Patients with a known primary tumour who have a solitary bone lesion detected by conventional radiography, CT and MRI
2. Differentiating primary from metastatic bone lesion, when the H/o primary lesion is not known
3. For evaluation of debilitated patients with bone lesion that are not readily accessible to open biopsy
4. In whom a long surgical procedure would not be tolerated
5. Evaluation of small round cell tumour with first approach to diagnosis
6. Radiographically typical lesion in an unusual age presentation
7. Suspected infection with radiographic features suggesting malignancy

A variety of needle are available for both trephine and aspiration biopsy

1. Vim Silverman
2. Westernan – Jensen Needle
3.Kormed needle
4. Craig needle
5. Meunier needle
6. Akerman needle
7. Jamsidhi needle
8. Vim tru cut needle
9. Thin walled needle

Contra indication of CNB :

Low platelet count < 50,000 (or) the presence of bleeding diatheses

Although CNB is less likely to result in complication its accuracy is far less than that possible with open biopsy.

Advantages of CNB over FNAC

Provides a chunk of tissue that allows to examine the tumour architecture. This is not possible with FNAC.

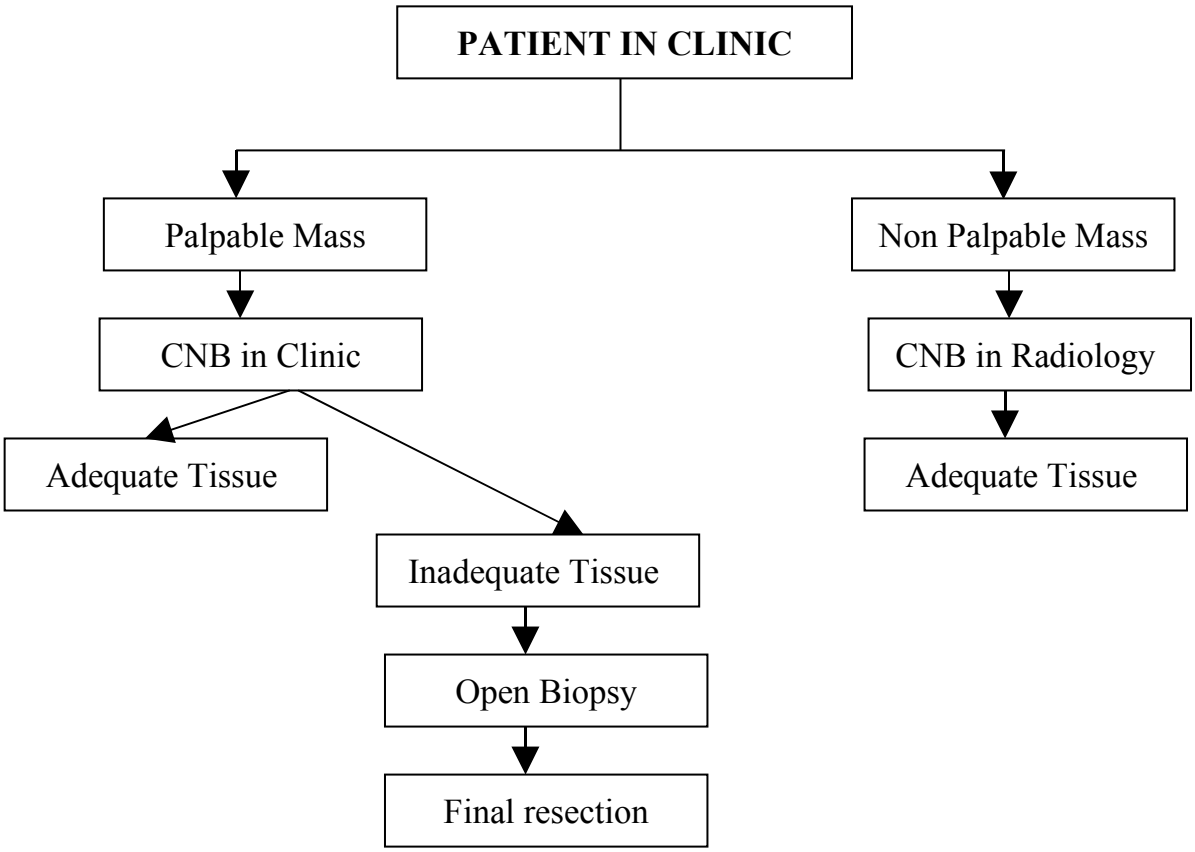
Disadvantages of CNB :

The biopsy procedure is relatively blind, so the ideal areas of the lesion may not be sampled.

OPEN BIOPSY

Open biopsy has been the most common and conventional method closed biopsy is gaining increasing popularity.

	Open biopsy	Closed biopsy
1.	Requires an incision under operating room condition	No incision is required. Tissue specimen is obtained following skin puncture by needle (or) trephine
2.	Decrease the likelihood of sampling error	
3.	Enable to obtain a relatively large amount of tissue for a diagnosis	
4.	Complications are more	No complications Accuracy of closed biopsy is 80%



Histological features favouring Benign and malignant lesions in bone tumors [5]

	Benign	Malignant
1.	Well circumscribed , non invasive	Permeation and invasive
2.	Absence of lamellar bone trapping	Presence of lamellar bone trapping
3.	If bone production, bone rimmed by at least a single row of osteoblasts	Absence of osteoblast rimming
4.	Soft tissue extension rare	Common
5.	Anaplasia lacking	Common
6.	Mitosis less commonly numerous and virtually never atypical	Mitosis numerous and often atypical

The biopsy should be regarded as a final diagnostic procedure. In any event it should be preceded by a careful evaluation of the clinical history, physical examination, analytical study of the pertinent X – ray picture and the consideration of any relevant hematologic and chemical laboratory data.

The surgeon, the radiologist and the pathologist, individually is able to view the diagnostic problem not only from his angle, but from that of the other two[11].

COMPARISON OF FINE NEEDLE ASPIRATION BIOPSY, CORE NEEDLE BIOPSY AND OPEN BIOPSY[5]

Characteristics	FNAC	CNB	Open Biopsy
Technical ease of procedure	Easily learned and applied	Easily learned and applied	Difficult, requires special training
Histological tissue	Usually most helpful for ancillary studies, not morphology	Helpful for morphology and ancillary studies	Helpful for morphology and ancillary studies
Speed of interpretation	Fast, often within minutes to hours	Tissue requires fixation and processing (1-2 days)	Tissue requires fixation and processing (1-2 days)
Risk of complications	Exceedingly low	Low, but higher than FNAC	Low, but significantly higher than either FNAC (or) CNB
Risk of tumour contamination of biopsy site	Exceedingly low	Low, but higher than FNAC	Low, but significantly higher than either FNAC (or) CNB
Accuracy rate for histological subtyping	Low	75 – 90%, more accurate for sub typing than FNAC	> 95%

Grading and staging of bone tumours

Largely through the efforts of Enneking and Colleagues, the orthopedic oncologists from Florida, a staging system has become universally accepted that is based on two criteria : histologic grade and the anatomic location of the tumour.

The first criterion for the staging system is the grade of the neoplasm. In one system, proposed by the National cancer institute, necrosis is very important factor in grading neoplasms. The authors believed that the more necrotic tumour, the worse the prognosis. The high grade tumours tend to be more necrotic[13].

The grading system is based predominantly on the cytologic characteristic of the tumour cells. If the tumour cells closely resemble the tumour cells from which they are supposed to arise, the tumour is well differentiated, if a tumour is so undifferentiated that one can hardly recognize the normal counterpart, the tumour is poorly differentiated. The authors grade most bone tumours from 1 to 4, depending on the nuclear changes and to a lesser extent, the cellularity of the lesion.

In the staging system of Enneking and colleagues, tumours are classified as low grade (or) high grade. The low grade tumours in Enneking system are grade 1 and 2 in the broders system and the high grade tumours in the Enneking system are grades 3 and 4 in the Broders system.

Enneking and Colleagues	**Broders**

Low grade	Grade 1
	Grade 2
High grade	Grade 3
	Grade 4

The anatomic location of the tumour depends on whether the lesions is confined to one compartment (or) involves more than one compartment for bone tumours, lesions confined within the bone are considered to be in one compartment, and lesions that have broken through the bone into soft tissues are considered to involve two compartments.

Low grade tumours are considered stage I, high grade tumours are stage II. A neoplasm of any grade that has metastasized is considered stage III. Each stage comprises subdivisions A and B, depending on whether the tumour involves one compartment or more than one compartment.

STAGING OF BONE NEOPLASMS

Stage	Grade	Site	Metastasis
IA	1	T_1	M_0
IB	1	T_2	M_0
IIA	2	T_1	M_0
IIB	2	T_2	M_0
IIIA	1,2	T_1	M_1
IIIB	1,2	T_2	M_1

T_1 : involves one compartment

T_2 : involves more than one compartment

(lesions that have broken through the bone into soft tissues)

M_0 : No metastatic tumours ;

M_1 : Metastatic lesions present

The two, three (or) four tiered grading systems currently used are based on the assessment of standard, morphologic criteria, including the degree of differentiation, cytologic atypia, mitotic activity and necrosis. The goal of different tiered system is to distinguish sarcomas associated with a low probability of dissemination (low grade; < 25% chance of metastasis) from those that are aggressive and have a high risk of system spread (high grade > 25% chance of metastasis) [2].

Histopathologic grading [2]

TNM two grade system	Three grade system	Four grade system
Low grade	Grade 1	Grades 1 or 2
High grade	Grade 2 (or) 3	Grades 3 or 4

Grade 1	**Grade 2 and 3**
Low grade	High grade
Hypocellular to moderately cellular	Moderately to densely cellular
Mild cytologic atypia	Moderate to severe cytoloic atypia
Few mitosis	Atypical mitosis
Minimal necrosis	More area of necorsis

American Joint Committee on cancer staging system of bone sarcomas[2].

Primary tumour

Tx : Primary tumour cannot be assessed

T0 : No evidence of primary tumour

T1 : Tumour ≤ 8cm in greatest dimension

T2 : Tumour > 8cm in greatest dimension

T3 : Discontinuous tumours in primary bone site

Regional lymph nodes (N)

Nx : Regional lymphnodes cannot be assessed

N0 : No regional lymph node metastases

N1 : Regional lymphnode metastasis

Distant metastasis (M)

Mx : Distant metastasis cannot be assessed

M0 : No distant metastasis

M1 : Distant metastasis

M1a : Lung

M1b : Other distant sites.

Prognostic significance of alkaline phosphatase measurements in patients with osteogenic sarcoma.

Alkaline phosphatase (AP) is an enzyme whose function is to catalyze the hydrolysis of monophosphoric esters in an alkaline medium. In bone, this enzyme is thought to be involved either in the calcification of bone matrix or in the protein synthetic activity associated with bone matrix production. Different isoenzymes of AP are produced by different organs and this has been used to localize the source of circulating serum AP[14].

Elevated levels of serum AP in the preoperative tumour bearing patient appear to be correlated with a poor prognosis. Serum AP levels almost always return to normal in the weeks following amputation.

Bone conditions other than osteosarcoma which results in elevated AP levels include

1. Fibrous dysplasia
2. Bone fractures

3. Osteomyelitis

Ancillary techniques in diagnosis of bone tumours

1. Histochemistry :

a. Periodic acid Schiff

The positive PAS reaction demonstrates mucopolysaccharides in new bone, calcifying cartilage. PAS assists in diagnosis of some mucinocus metastic tumours and primary tumours with glycogen Ex : Ewings sarcoma, PAS is very much helpful in differentiating Ewings sarcoma from small cell variant of osteosarcoma. The presence of PAS positive glycogen within the cytoplasm of tumour cells (as demonstrated by PAS stain) is diagnostic of Ewings tumour[33].

b. Techniques for the demonstration of acid phosphatases

Gomari (1941) Alkaline phosphatase technique – Tumour cells are intensely positive for alkaline phosphatase in osteosarcoma, a feature of diagnostic value.

c. Reticulin stains is useful in the differential diagnosis of Ewings sarcoma and malignant lymphoma

This histochemical characteristics helps to distinguish a primary bone lesion from metastatic pleomorphic malignancies such as spindle or anaplastic sarcoma like carcinoma, melanoma and primary spindle cell sarcoma of bone.

2. Electron microscopy (EM) :

EM examination of aspirated material may help to confirm the presence of osteoid.

Ultra structurally, the better differentiated osteosarcoma tumour cells resemble normal osteoblasts in their abundance of dilated cisternae of granular endoplasmic reticulum and sparse mitochondria. The matrix is formed of non periodic fibrils, scattered collagen fibers, and focal calcium deposits of hydroxyapatite crystals[3].

The cells of well differentiated tumours show cytoloplasmic accumulation of glycogen, lipid droplets and dilated cisternae of granular endoplasmic reticulum.

The cells of Ewings sarcoma show a rather primitive appearance. Occasionally, a few dense core granules will be found, either in the cytoplasm or in the cell prolongations.

3. Immunohistochemistry

Cells of osteosarcoma consistently express vimentin. In some cases, smooth muscle actin and desmin are positive. S – 100 protein is always present in foci of chondroid differentiation, proteins – osteonectin, osteocalcin, osteopontin, bone morphogenetic protein have been identified in cells of osteosarcoma and may be of utility in differential diagnosis of osteosarcoma.

Cells of chondrosarcoma are positive for S100 protein and collagens type II and V

Cells of Ewings sarcoma are consistently positive for vimentin. Postivity has been described for neuron specific enolase, protein gene product 9.51 Leu 7 and neunofilament. CD99 is a cell membrane protein coded by a gene located

on the short arms of the X and Y chromosomes that is consistently expressed by the cells of Ewings sarcoma.

Cells of chordoma shows reactivity for S100 protein, keratin, epithelial membrane antigen, HBME – 1, cathepsin, but only rarely for CEA. Strong 5 – nucleotidase positivity has been found in the cell membrane of the tumour cells, another features of diagnostic utility[3].

4. Molecular genetic studies :

The most common cytogenetic abnormalities detected in osteosarcoma involve chromosomes 1,2,6,12.

Over 95% of the cases of Ewings sarcoma show on cytogenetic examination the reciprocal translocation 11 : 22 (q24 : q12) which result in fusion of the EWS gene with the FL1 genes. These translocation has been detected by RT – PCR, FISH technique in fresh frozen sections and paraffin sections[3].

MATERIALS AND METHODS

The present study analyses the role of FNAC in the diagnosis of bone lesions in comparison with other techniques.

110 patients with bone tumours were referred to Pathology Department for diagnosis during the period from 2004 to 2006. All had been examined by plain radiography, CT and (or) MRI patients with suspected local recurrence of

a primary malignant bone tumour (or) a metastatic lesion of a previously diagnosed malignancy were also included in our study.

Methods

Procedure of FNAC:

We performed fine needle aspiration cytology as an outpatient procedure after studying the x – ray of the patient.

Requirements

1. Syringe 5-10 ml disposable
2. Needle 23-18 guage with 2.54 to 3.8cm length
3. Glass slides : clean, dry, free of grease and dirt
4. Isopropyl alcohol fixation
5. Gloves
6. Skin disinfectants, cotton swabs, sterile dressing
7. Culture bottle – if required

Aspiration technique :

After preparation of the patient and careful scrutiny of X – ray, the biopsy needle is introduced along the long axis of the lesion into the extra osseous compartment. A vaccum is created by pulling back the plunger of the syringe and the aspirate is obtained by moving the needle in a gentle back and forth motion while continuing to apply suction, there by drawing tissue into the

needle. After several seconds, the suction is released and the needle is withdrawn from the lesion.

Each aspirate was placed on to a several slides, smears prepared, and fixed in isopropyl alcohol. They were routinely stained with hematoxylin and eosin. The various cytomorphological features of bone lesions were studied, analysed and placed in appropriate category.

CYTOLOGICAL FINDINGS IN BONE TUMOURS

Normal structure : seen in FNA of bone lesions

1. Haematopoietic tissue
2. Osteoblasts – are commonly seen in aspirates from all kinds of bone lesions
3. Osteoclasts
4. Chondrocytes
5. Cartilage
6. Mesothelial cells – seen in smears from spinal aspiration

Neoplasms :-

Benign tumours of bone

1. Giant cell tumours (GCT) :

Shows cellular smear with giant cells of osteoclastic type and mononuclear spindle cells in the stroma. The gaint cells are typically attached to the periphery of clusters of spindle cells[5].

2. Chondroma :

Shows predominatly cartilaginous tissue fragments and cells in lacunar spaces within fragments. The chordromyxloid ground substances is usually abundant. The tumour cells are uniform and rounded with a well defined cytoplasm, rounded nuclei and one (or) two nucleoli

3. Chondroblastoma

Fragments of chondroid matrix and double cell population are the clues to the diagnosis. They are mononuclear and rounded with well demarcated cytoplasm and rounded, lobulated (or) renifrom nuclei. Another cells are multinucleated osteoclastic type of giant cells.

4. Chondromyxloid Fibroma

Smears show a mixture of chondroid fragments, fibroblast like spindle cells and osteoclast like giant cells embedded in myxoid material.

Primary malignant tumours of bone :

1. Osteosarcoma

Smears contain both dissociated neoplastic cells and cell clusters. Osteoid is seen as clumps of amorphous, faintly eosinophillic material in the background (or) between cells in clusters. Both benign osteoclastic giant cells and malignant giant cells with pleomorphic nuclei are commonly seen. Pleomorphic spindle and rounded cells and tumour cells resembling osteoblasts are seen.

The hallmark of chondroblastic osteosarcoma on FNA is the characteristic gelatinous chondroid matrix.

2. Chondro Sarcoma.:

Criteria for diagnosis

1. Predominantly tissue fragments in lowgrade tumours, single cells may predominate in high grade sarcoma
2. Abundant eonsinphillic, vacuolated cytoplasm
3. Chondromyxoid material.

The tumor cells have a well defined cytoplasm and rounded nuclei with one (or) two nucleoli, binucleate cells are presnet and nuclear pleomorphism is of moderate degree.

3. Chordoma

The characteristic findings are the abundant background of myxoid ground substance and the large, physaliphorous cells with abundant pale, vacuolated, buddly cytoplasm and well defined cell borders. Clusters of markedly pleomorphic cells with rounded nuclei are seen.

4. Ewing's sarcoma

Smears are highly cellular and are composed of both single cells and groups of loosely cohesive cells. There is a characteristic mixture of two types of cells. One has abundant pale cytoplasm with vacuoles (or) large clear spaces, rounded or ovoid nuclei with a dense chromatin. The cytoplasmic vacuoles (or) clear spaces correspond to large deposits of glycogen.

5. Malignant lymphoma

Cytologic criteria for diagnosis are

i. A monotonous population of small lymphoid cells

ii. Mainly round nuclei slightly larger than those of normal small lymphocytes

iii. Charactertically coarse granular nuclear chromatin

6. Langerhans cells histiocytosis : (Eosinophillic granuloma)

The characteristic histiocytes have moderately larger and paler nuclei with irregular and folded outline. The chromatin is entirely bland and nucleoli are small. The cytoplasm is abundant and pale and has fairly well defined borders and is often vacuolated.

Variable numbers of eosinophils and giant cells of histiocyte type are seen.

Vascular lesions :

Hemangioma :

Only blood is aspirated A few cells may be present among the blood, such as strands of endothelial cells, hemosiderin containing macrophasges osteoblasts and fibroblasts.

Solitary plasmacytoma[5]

Smear shows uniform dispersed population of plasma cells including multinucleate and pleomorphic forms. The eccentric nucleus with speckled (or)

clock face chromatin and the abundant amphophilic cytoplasm and a clear cytoplasmic zone near the nucleus is another distinctive cytologic feature.

Core Needle Biopsy :

Core needle biopsy is another method of diagnosing bone tumours. The amount of diagnostic material varies depending on the size of the needle used for the procedure which can range from 18-11 (or) 12 guage. A needle biopsy is performed by a radiologist / orthopaedicians under CT (or) ultra sonographic guidance. The specimen typically consists of smear and biopsy tissue. Core needle biopsies were placed in 10% formalin, processed and embedded in paraffin wax, sectioned and stained for routine histopathological examination.

Handling of Specimens :

Most bone neoplasm with soft tissue were processed without decalcification.

Rare tumours ex: osteoid osteoma, parasteal osteosarcoma were mineralized and needed decalcification.

If the resected specimens received contains both soft and hard fragments, the hard materials were separated from the soft tissue, especially in the case of small cell neoplasm,

For decalcification, we used 5% nitric acid in 10% formalin.

For resected specimens of bone tumors we usually dissect away all the soft material, leaving only the involved bone and soft tissue extension by the neoplasm.

Using a bone saw, we bivalve the bone with the tumours. Even thin slices of bone can be prepared for decalcification with the bone saw.

Amputation specimens were handled in the same way as resection specimens.

Procedure of hematoxylin and eosin stain :

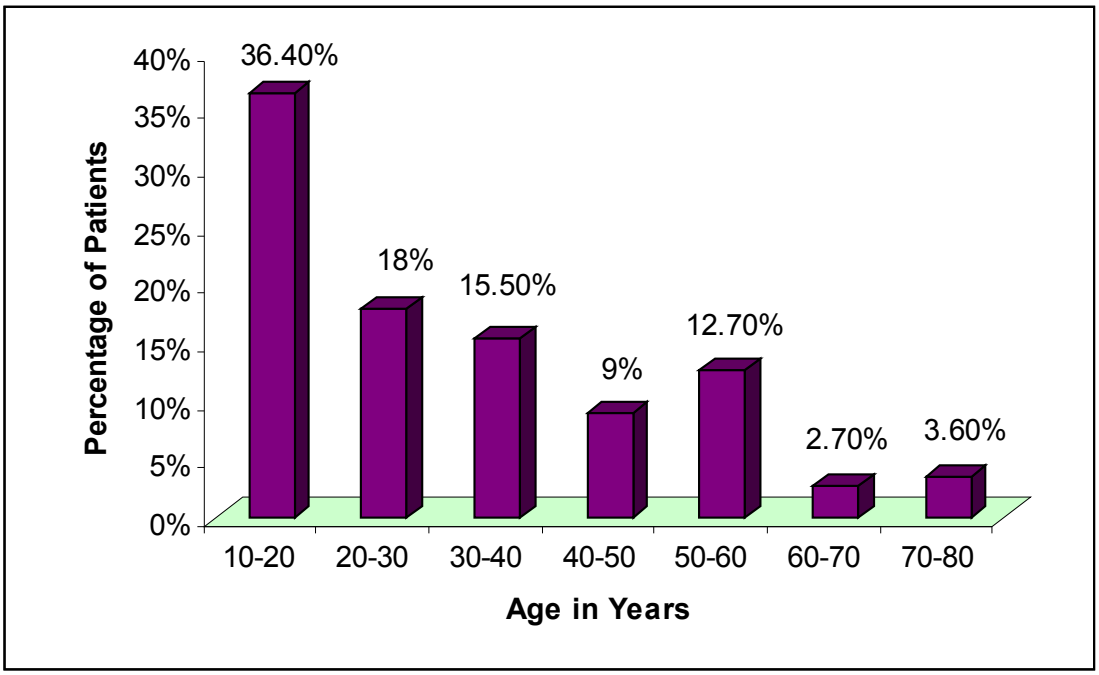
- Dewax the section, dehydrate through graded alcohol to water
- Remove fixation pigments if necessary
- stain in hematoxylin for 5 minutes
- Wash well in running tap water
- Differentiate in 1 percent acid alcohol for 2-4 seconds
- Wash well in running tap water until sections are again blue for 15 to 20 minutes
- Stain in eosin for one minute
- Wash in water for 5 minutes
- Dry and mount the slide.

RESULTS

Out of 110 patients with bone tumours, FNAC was done for 67 patients. The cytological diagnosis was compared with histological diagnosis after needle biopsy and open biopsy in 47 cases. In 20 cases, there was no histological confirmation and the diagnosis was based on cytological analysis in combination with radiological and clinical features.

AGE AND SEX DISTRIBUTION OF PATIENT AT INITIAL DIAGNOSIS

Chart – 1



A slight male predominance was noted (1.3.1) Ages at initial presentation ranged from 2 to 70 yrs (median age 16 years). The majority of the patients (36.4%) were with in the 2nd decade of life at the time of initial diagnosis.

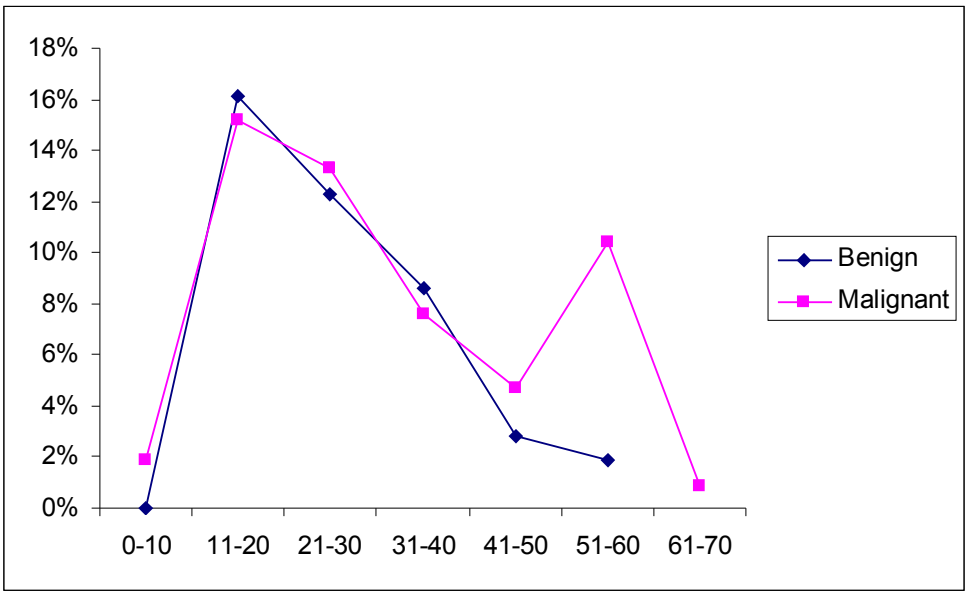
AGE AND SEX INCIDENCE IN BONE LESIONS (TABLE 1)

Age in years	Benign		Malignant		Total
	Male	Female	Male	Female	
< 10	-	-	2	-	2
11-20	12	5	10	6	33
21-30	7	6	9	5	28
31-40	5	4	5	3	17
41-50	1	2	3	2	8
51-60	2	-	7	4	13
61-70	-	-	1	-	1
71-80	-	-	2	1	3
Total	27	17	39	22	105

Chart – 2

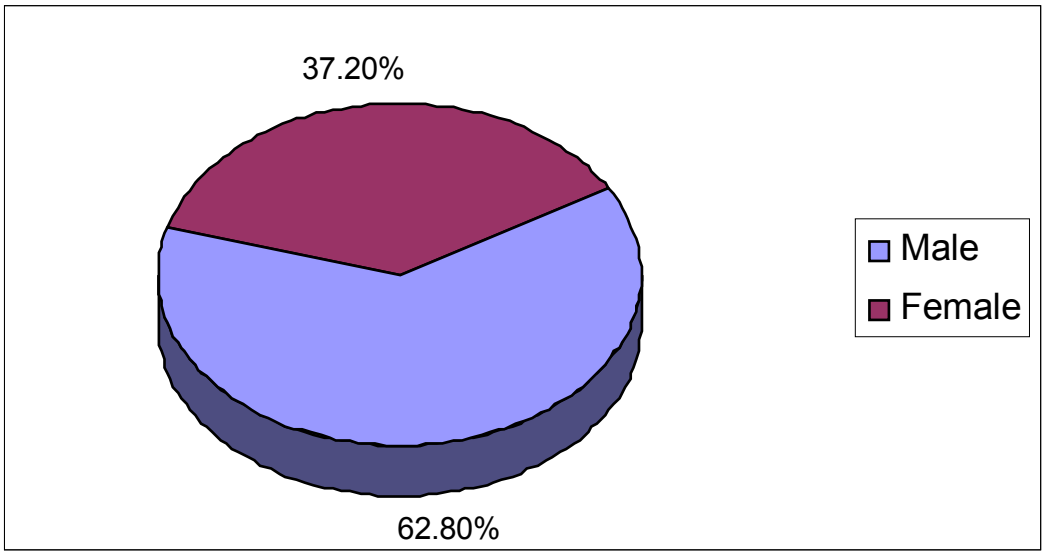
Age Specific Incidence of Bone Lesions

(Benign and Malignant)



INCIDENCE OF BONE LESIONS IN MALES AND FEMALES

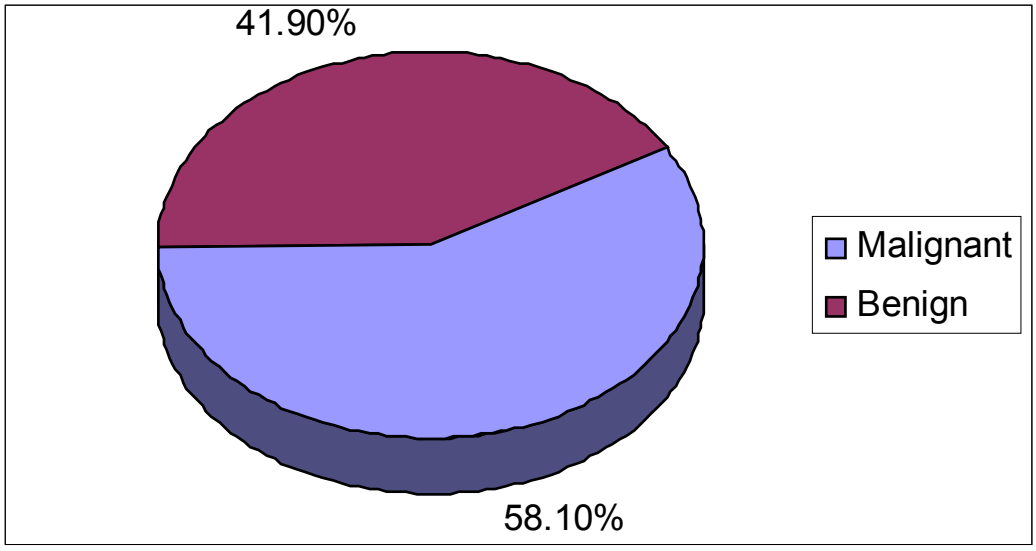
Chart – 3



A slight male predominance was noted (1.3 .1). Males constitute about 66 cases (62.8%) and females constitute about 39 cases (37.2%).

Incidence of bone lesions (Benign and malignant)

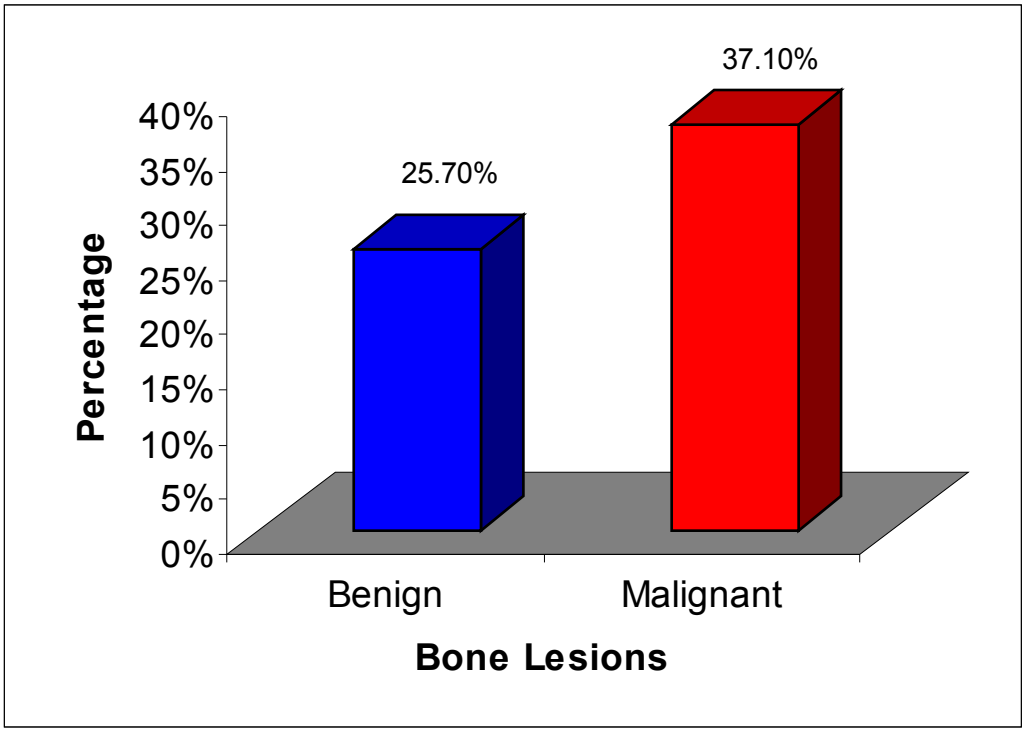
Chart - 4



Out of 110 cases, there were 5 cases with inadequate material, excluded from the study. Of 105 cases, malignant constitutes about 58.1% and benign constitutes about 41.9%.

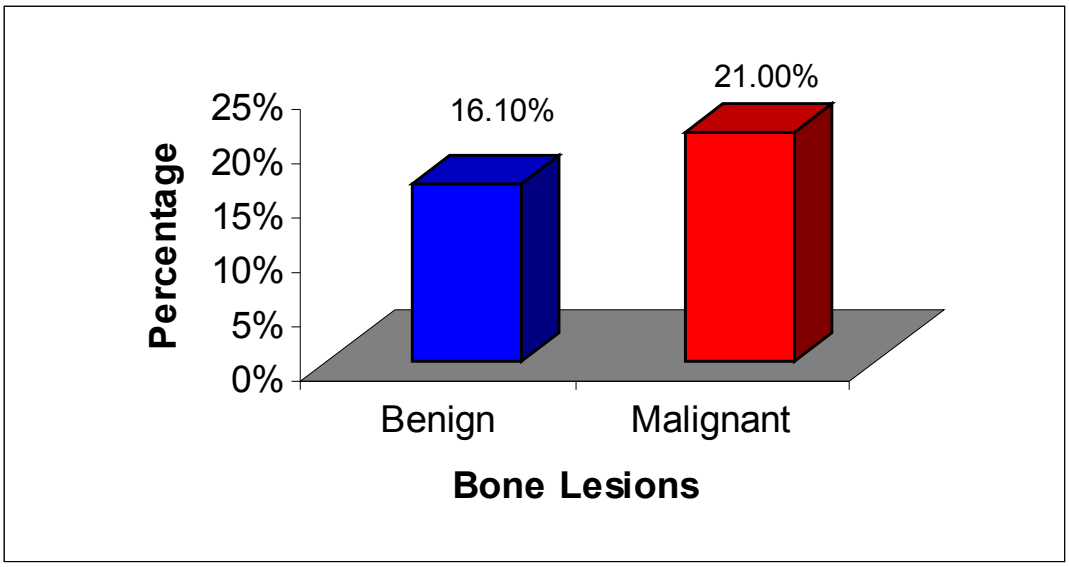
INCIDENCE OF BONE LESIONS IN MALES

Chart – 5



INCIDENCE OF BONE LESIONS IN FEMALES

Chart – 6



Both benign and malignant bone lesions are more common in males than in females.

DISTRIBUTION OF TUMOURS ACCORDING TO ANATOMIC SITE (TABLE 2)

SITE	NO. OF CASES
Femur	50
Tibia	16
Humerus	8
Radius	8
Ileum	5
Ischium	1
Vertebra	5
Metatarsal	4
Metacarpal	2
Pelvis	2
Sternum	1
Nasal Bone	1
Scapula	1
Rib	1
Skull	2
Fibula	1
Maxilla	1

Of 110 cases, the two most common site of presentation of bone tumours were the femur (50 cases) and the proximal tibia (16) cases, representing the two thirds of the cases. Other sites included the humerus, radius, pelvis, ileum and vertebra. Of 67 FNA cases, there was no histological

confirmation for 20 cases and the diagnosis was based on cytological analysis in combination with radiological and clinical features.

NATURE OF THE ASPIRATE

(TABLE 3)

Nature of Aspirate	No of Cases	%
Adequate material	61	91%
Scant material	2	3%
Acellular (unsatisfactory)	4	6%

Adequate material for evaluation was obtained in 91% cases. Inadequate material for diagnosis was attributed to hemarrhagic material, necrotic material and paucity of material (2 cases in periosteal osteosarcoma).

GCT were seen to yield a large amount of material. Aspiration cytology is very effective in this tumour type. However clinico-radiological data must be considered to differentiate from other giant cell variants. Similarly round cell tumours also yielded abundant material making FNA the ideal diagnostic procedure in this tumor type.

The technique of FNA seems to be ideally suited for the diagnosis of lytic bone lesions. One limitation of the technique is the difficulty in sampling a lesion that is covered by compact bone.

Diagnostic accuracy of FNAC of benign bone lesions

(TABLE 4)

Benign lesions	Correct	Incorrect	Inconclusive
GCT	15	-	1
Other benign			
Cartilaginous tumours	2	1	3
Osteochondroma	1	-	-
Non ossifying fibroma	1	-	-

DIAGNOSTIC ACCURACY OF FNA OF MALIGNANT BONE LESIONS

(TABLE 5)

Malignant Lesions	Correct No. of cases	Incorrect No. of cases	Inconclusive No. of cases
Osteosarcoma	5	3	1
Chandrosarcoma	2	-	-
Ewings Sarcoma	2	1	-
MFH	1	-	-
Large cell lymphoma	1	-	-
Secondary deposits	3	-	1

DIAGNOSTIC ACCURACY OF FNAC OF BONE LESIONS

(TABLE 6)

Diagnosis	Total no. of cases	Percentage
Accurate	32	76.2%
Inconclusive	5	12.4%
Falsely benign	2	4.8%
Falsely malignant	2	4.8%

Materials considered conclusive for cytological diagnosis was obtained in 67 of the 110 cases.

A total of 25 lesions were cytologically assessed as benign. This was correct in 19 (76%) cases. One GCT was diagnosed as osteosarcoma.

30 cases were diagnosed as malignant and this was correct in 24 cases (80%).

Of the 30 malignant cases, the cellular yield was insufficient (or) inconclusive in 2 cases. It required open biopsy to give the final diagnosis. These two cases were diagnosed as periosteal osteosarcoma by open biopsy and one as osteosarcoma telengiectatic variant.

Of 4 metastatic deposits, the diagnosis was correct in 3 cases and inconclusive in one case, which was diagnosed as metastatic deposits by CNB and open biopsy.

The overall rate of correct cytological diagnosis was 76.2%. Falsely benign diagnosis was 4.8%. one osteosarcoma was diagnosed as GCT.

Falsely malignant diagnosis was 4.8% one Aneurysmal bony cyst (ABT) with focal GCT transformation was diagnosed as synovial sarcoma.

One Ewings sarcoma was diagnosed as fibroblastic osteosarcoma.

Role of core needle biopsy in the diagnosis of bone tumours

A definitive diagnosis is made on the basis of the tumour histology and the clinical and radiographic confirmation.

Out of 110 cases, we received 30 core needle biopsies. Of 30 cases of CNB, resected specimens for 17 cases were received. For 13 cases, no resected specimens were available. Two biopsy procedures were performed under radiologic guidance, one under CT and another under USG.

DIAGNOSTIC ACCURACY OF CORE NEEDLE BIOPSIES OF BONE LESIONS

(TABLE 7)

Diagnosis	**Total no. of cases**	**Percentage**
Accurate	13	76.5%
Inconclusive	4	23.5%
Falsely benign	2	11.76%
Falsely malignant	-	-

Out of 17 CNB with confirmation 13 cases were diagnosed accurately (76.5%) and the material was inadequate in 4 cases (23.5%) and 2 cases were falsely diagnosed as benign. One osteosarcoma was diagnosed as chondromyxoid fibroma and one chondrosarcoma as benign chondroma.

One GCT was given as chondromyxoid fibroma and one osteitis fibrosa cystica was given as Aneurysmal bone cyst.

ADEQUACY OF MATERIAL IN CNB

TABLE 8

	Total no. of cases	Percentage
Adequate material	29	96.7%
Inadequate	1	3%

Out of 30 cases, a single core needle biopsy procedure was adequate in 29 cases (96.7%) and inadequate in only one case (3%).

Comparison of results of this study with previously published data[15].

(TABLE 9)

Study	Years	No. of biopsies	Adequate tissue%	Accuracy %
Washington Cancer Institute (WCI)	1992 – 1997	185	90.1%	72.7 – 92%
Prior data	1979 – 1997	472	83-100	64-100
Present Study	2004- 2006	30	96.7%	76.5%

Barth et al in a direct comparison of FNAC and core needle biopsy reported the core needle biopsy to be more accurate[15].

The distinct advantage of a core needle biopsy is that it provides a chunk of tissue that allows the pathologist to examine the tumour architecture and interrelation of its cells. This is not possible with FNAC.

In addition, a specimen taken from CNB can be subject to all of the special tests (or) stain to help determine the diagnosis.

Out of 110 cases, resected specimens were available for 3 open biopsies. Histopathological diagnosis of open biopsies were compared with histological diagnosis after resection of the tumours. The diagnosis was correct in 3 cases.

One case was given as GCT in both open biopsy and resected specimen. Other case was given as pleomorphic spindle cell sarcoma in the nature of malignant fibrous histiocytoma in both open biopsy and resected specimen. One case was diagnosed as chondroma in resected specimen and as recurrent chondrosarcoma in open biopsy later.

DISCUSSION

Our study suggest that FNAC is a valid option in the diagnosis of bone tumours. It s a simple outpatient procedure which offers sufficient tissue materials for the correct diagnosis in 76.2% of tumours. As with the open biopsy, however the cytological assessment must agree with the clinical and radiological findings. Our results are encouraging, but FNAC cannot completely replace open biopsy.

Dollahite et al in 1989 who reported a diagnostic accuracy of 83% of GCT, but a significantly lower rate for bone lesions thought to be benign[8]. .In our study diagnostic accuracy for GCT is 90%.

In out study, the main reason for failure was inadequate sampling rather than diagnostic difficulties.

In a comparitive study of 67 bone tumours Agarwal and Wahal (1983) showed diagnostic agreement between cytology and histopathology in 83%.

All failures were due to insufficient cytological material. Efforts should be made to improve the technique of obtaining adequate material.

The needle can be guided in different directions. Cortical bone has been penetrated and the device can easily be inserted at different sites in cortical bone without causing any major discomfort to the patient. This is important, since it is well known that a bone tumour can vary considerably histologically and tissue must be obtained from different areas of the same lesion.

For most bone tumours, however the distinction between benign bone tumours, malignant bone tumours, lymphomas, myelomas and metastatic lesions is sufficient for correct management.

As regards treatment, it is very important to establish the correct histogenic tumour type and grade for conditions which required preoperative chemotherapy such as osteosarcoma and Ewings sarcoma.

As regards primary malignant bone tumours, our result imply that the greatest diagnostic difficulties are found with chondrosarcoma and periosteal osteosarcoma.

In cytological study of 14 cases of Ewings sarcoma, Akerman and Angervell (1986) concluded that the smear have characteristic appearance and that FNAC can be used for primary diagnosis and also for chromosomal analysis to reveal the typical 11 : 22 translocation of Ewings sarcoma. Osteosarcoma seems to be more cytodiagnostic difficulties than Ewings sarcoma but less so than chondrosaroma[8].

In our study of 9 cases of cytologically diagnosed osteosarcoma, 5 cases are correct (55%), 3 cases are incorrect and inadequate in one case of telengiectactic variant of osteosarcoma. One case was reported as GCT with secondary ABC changes, another as chondrosarcoma and other as adenocarcinoma deposits. In 4 cases of cytologically diagnosed chondrosarcoma 2 cases are correct (50%).

Walas and Kindflom (1990) studied 20 high grade osteosarcomas, all the cytological specimens showed features suggestive of primary bone malignancy. The distinction however between chondroblastic osteosarcoma and high grade osteosarcoma and malignant fibrous histiocytoma proved to be difficult on smears.

There were 23 malignant bone tumours excluding secondary metastatic deposits with a biopsy accuracy of 91% and 25 benign tumours with a biopsy accuracy of 80% and metastatic tumours with a biopsy accuracy of 75%.

In the future, efforts should be focused on an improved biopsy technique to obtain a higher rate of conclusive cytological material. This can be done by an improved instrument design to facilitate multiple aspirates through cortical bone and also by wider application of CT.

Improved diagnostic accuracy can be attained by the use of complementary methods such as electron microscopy and immunohistochemistry.

Objective methods such as DNA cytometry, proliferative rate assessments, karyotyping and molecular genetics may also be of value.

These methods combined with clinical experience should reduce the need for open biopsy of bone tumours.

DIAGNOSTIC ACCURACY OF FNAC – COMPARATIVE ANALYSIS

(TABLE 10)

S.No.	Authors Name	Diagnostic Accuracy
1.	Texas M.D. Anderson Hospital[6] (1978-1986)	80.4%
2.	Arti Bhatia 1989[9]	89%
3.	Andris Breicbergs[8]	95%
4.	Present study	76.2%

Out of 47 cases, 32 cases are correctly diagnosed with adequate material. The most common benign tumours are GCT. The most common malignant tumours are osteosarcoma.

ACCURACY OF ASPIRATE – COMPARITIVE ANALYSIS

(TABLE 11)

S.No.	Authours Name	Satisfactory Aspirate	Unstatisfactory Aspirate	Falsely Benign	Falsely Malignant
1.	Andri Kreicbergs [8]	80%	16%	3%	0.3%
2.	Texas MD Anderson Hospital[6] (1978-1986)	85.7%	14.2%	-	-
3.	Arti Bhatia[9] (1989)	92%	8%	-	-
4.	Present Study	87.2%	12.4%	4.8%	4.8%

Out of 47 cases, a satisfactory sample for evaluation of cytological findings was obtained in 42 cases (87.2%) and in 5 cases (12.4%) the material was considered un satisfactory for reporting.

The accuracy rate of open biopsy is almost 100%. The one case of chondroma and subsequent report chondrosarcoma can be explained by differentiation of cartilaginous bone tumours, which is very common.

Fig : 1 :- GCT showing eccentrically located expansile lesion – Distal end of radius

Fig: 2:- GCT showing expansile and hemarrhagic lesion – Distal end of radius

Fig: 3:- Chondrosarcoma infiltrating in to the surrounding soft tissue - Distal radius

Fig: 4:- Chondrosarcoma - lobular cartilaginous mass showing gelatinous and hemorrhagic areas - Distal radius

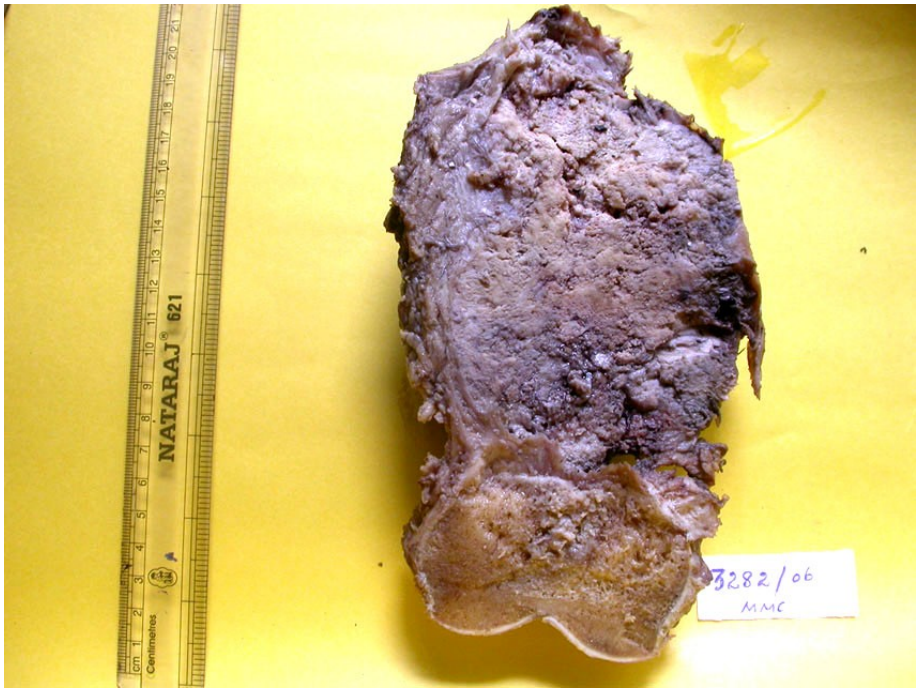


Fig: 5:- Conventional osteosarcoma – Tumour is located at metaphysis with extension in to diaphysis involving the surrounding soft tissue.

Fig: 6:- Periosteal osteosarcoma showing lesion at the external surface of the bone – Lower end of femur.

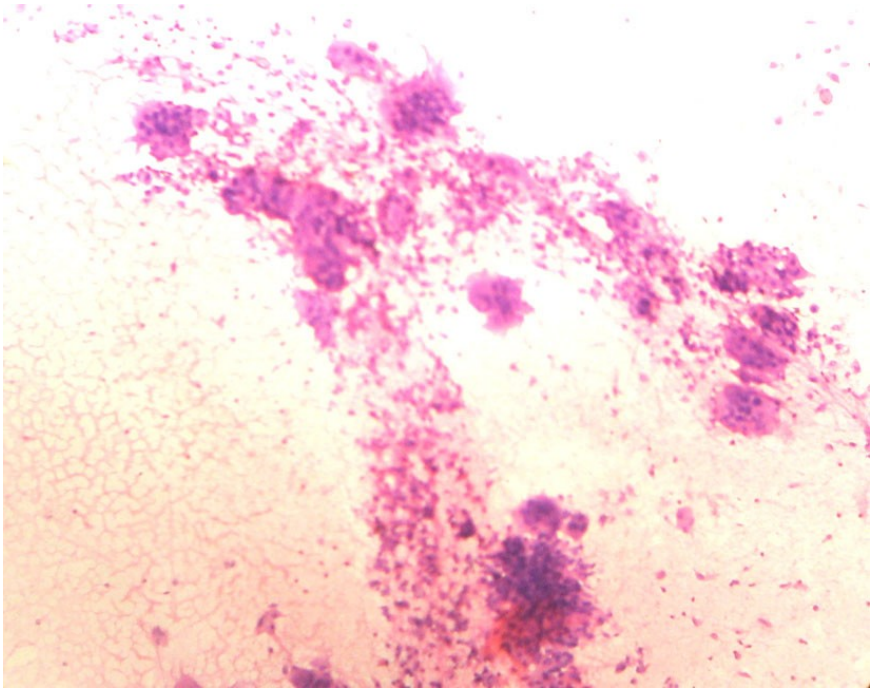


Fig: 7:- GCT showing osteoclastic giant cells and mononuclear spindle cells in the stroma. HPE (x 100)

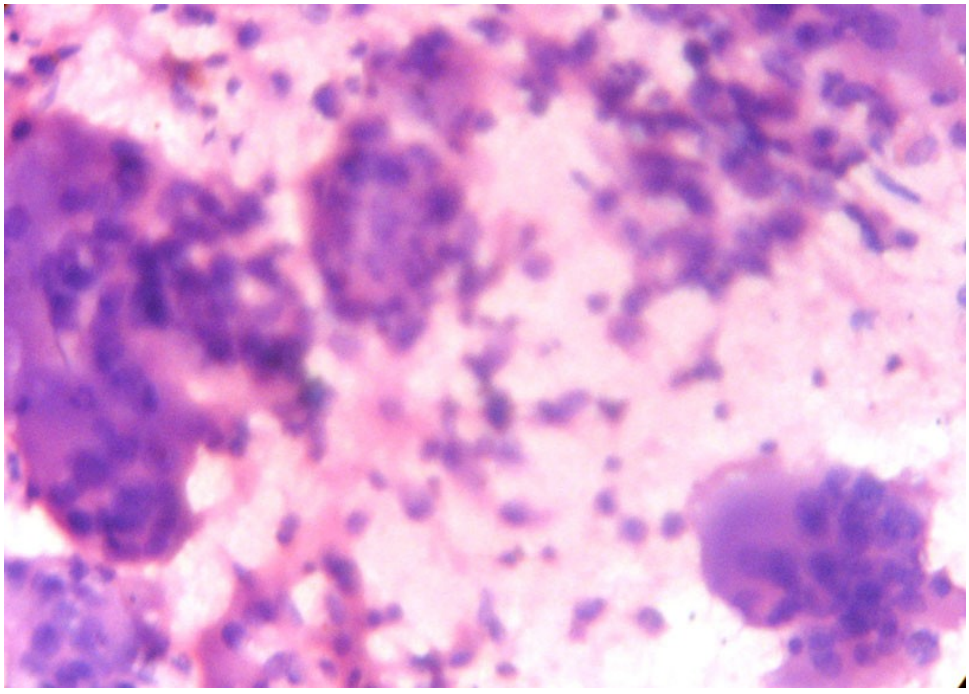


Fig: 8:- Giant cell tumour H& E (x 400)

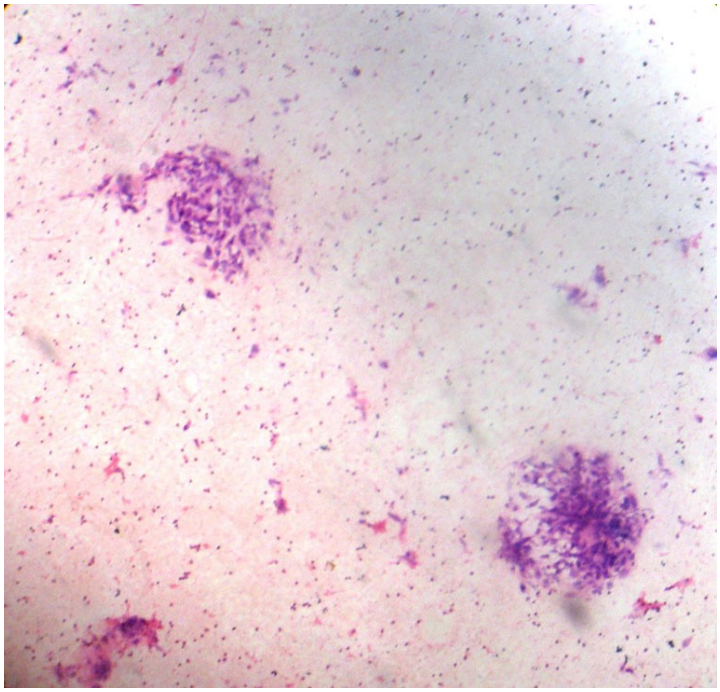


Fig: 9:- Osteosarcoma showing pleomorphic spindle ad round cells-H & E (x 100)

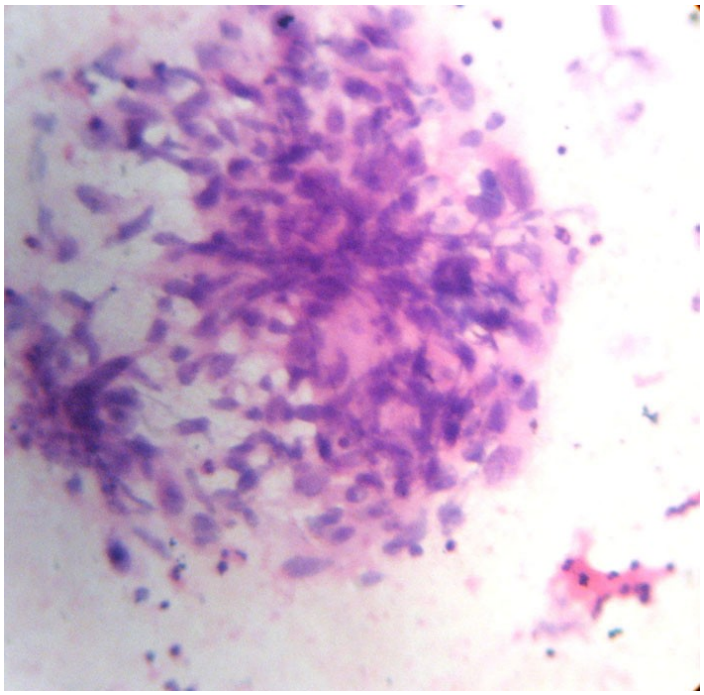


Fig: 10:- Osteosarcoma showing osteoid in between cells in clusters H &E(x 400)

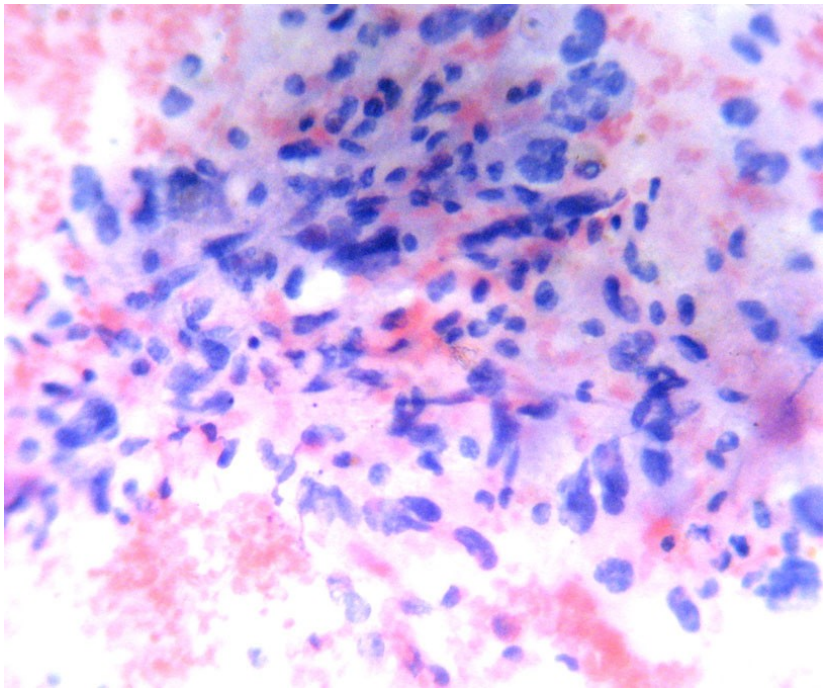


Fig: 11:- Chondroblastic osteosarcoma showing pleomorphic sarcoma cells in chondroid matrix H &E(x 100)

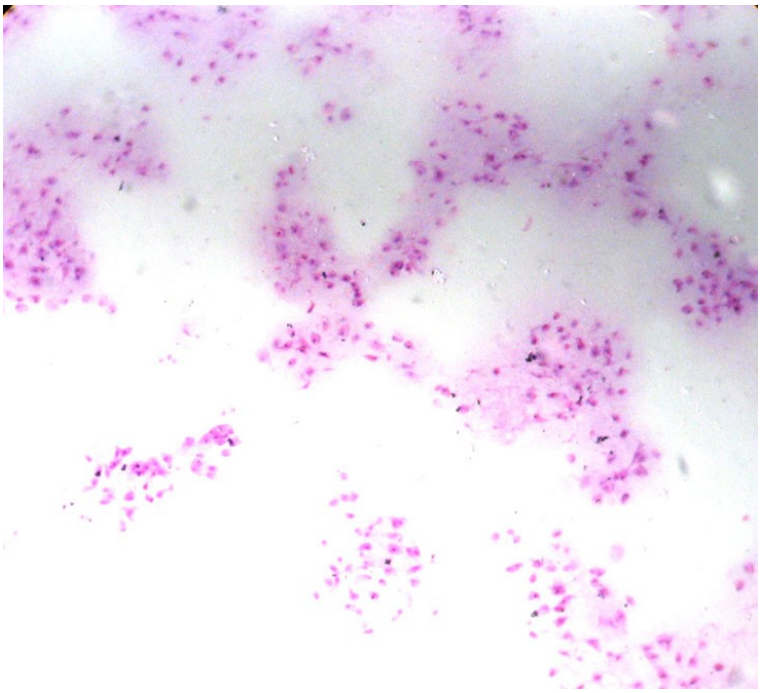


Fig: 12:- Chondrosarcoma showing irregular nuclei and binucleate forms in chondroid matrix H &E(x 100)

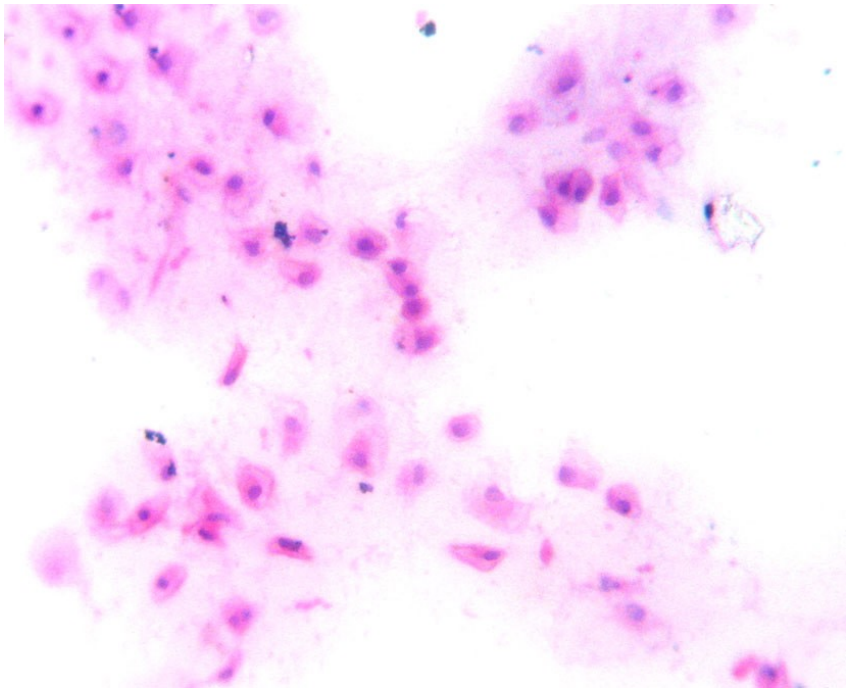


Fig: 13:- Chondrosarcoma H &E(x 400)

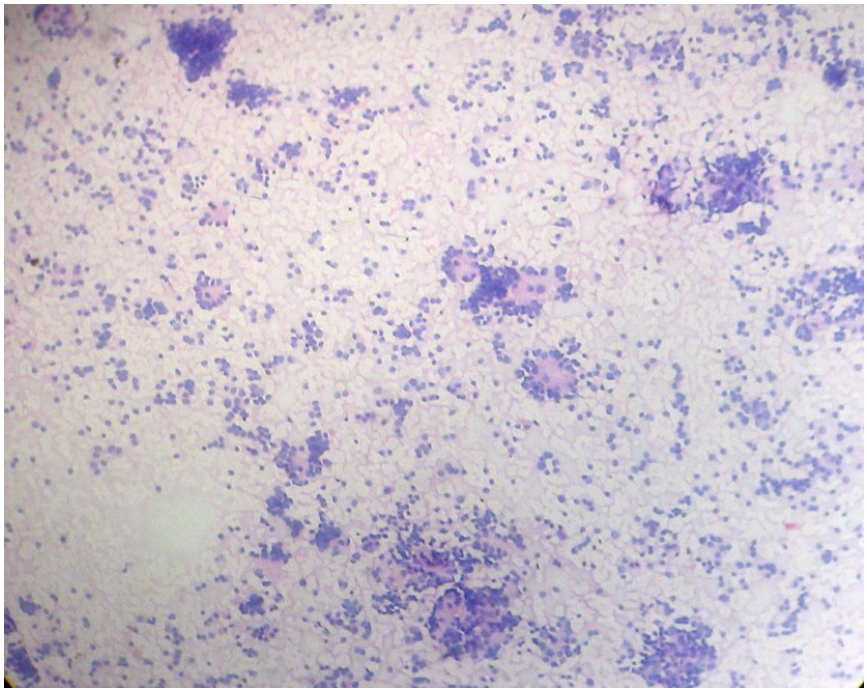


Fig: 14:- Ewings sarcoma - Rosette like arrangement H&E (x 100)

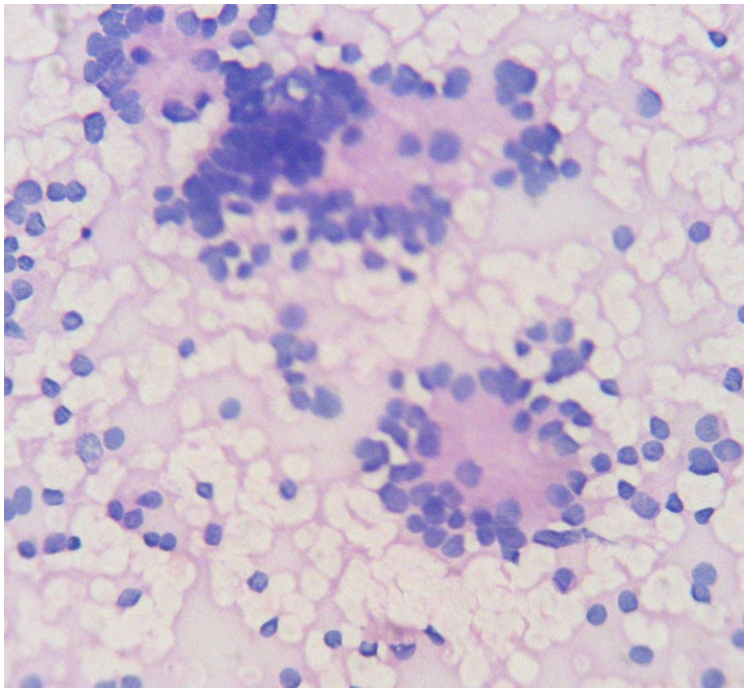


Fig: 15:- Ewings sarcoma – showing uniform small round cells with scanty cytoplasm and Rosette like structures H&E (x 400)

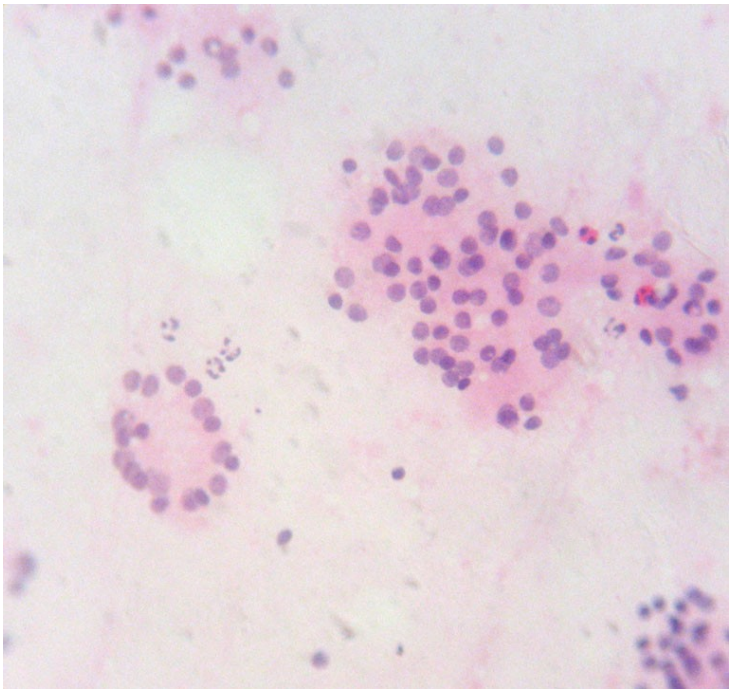


Fig: 16:- Secondary deposits from thyroid showing follicular arrangement of thyroid epithelial cells – follicular carcinoma H&E (x 100)

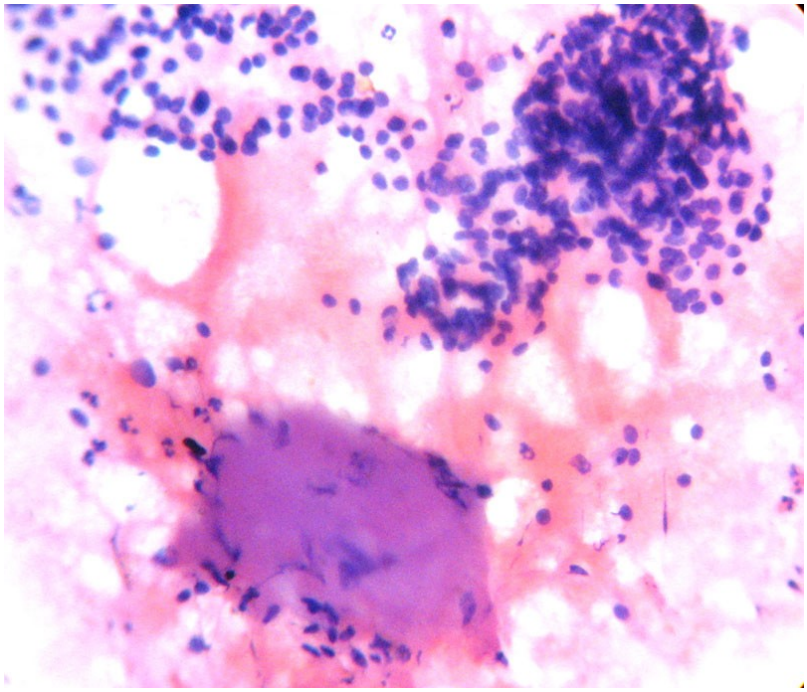


Fig: 17:- Secondary deposits from follicular carcinoma thyroid showing colloid H&E (x 400)

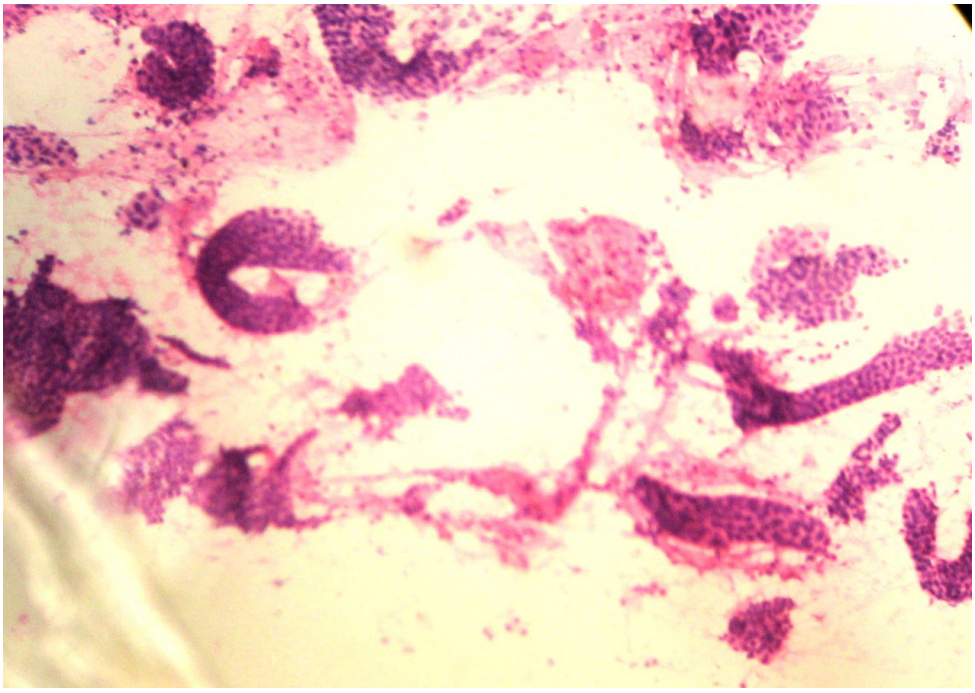


Fig: 18:- Secondary deposits from squamous cell carcinoma H&E (x 100)

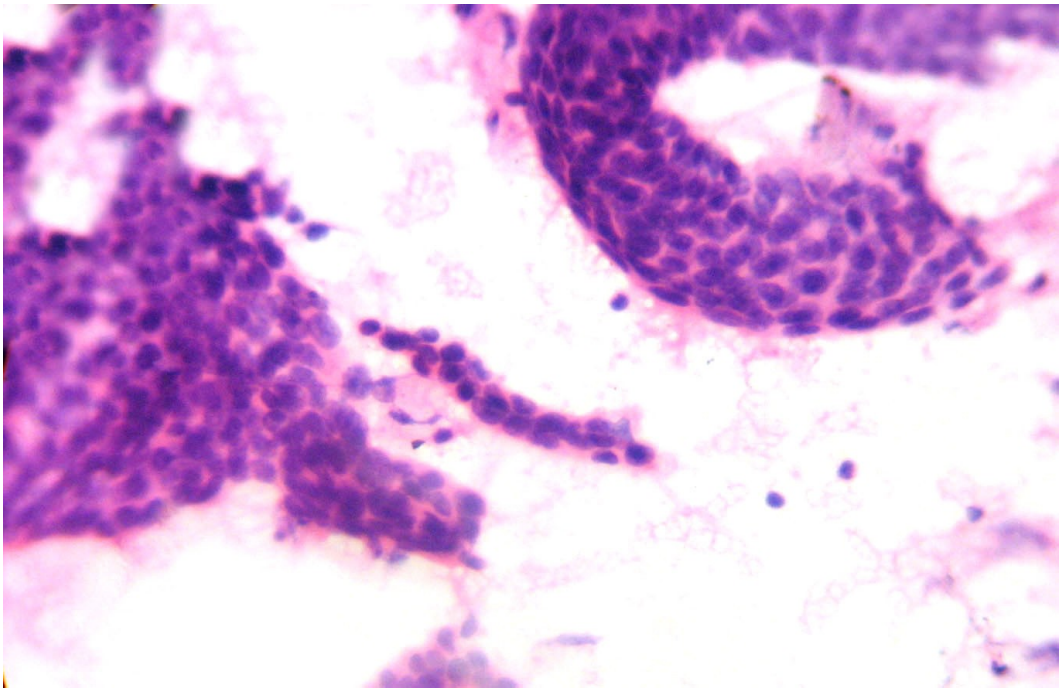


Fig: 19 :- SCC deposit showing pleomorphic cells with dense cytoplasm and well defined cell borders H&E (x 400)

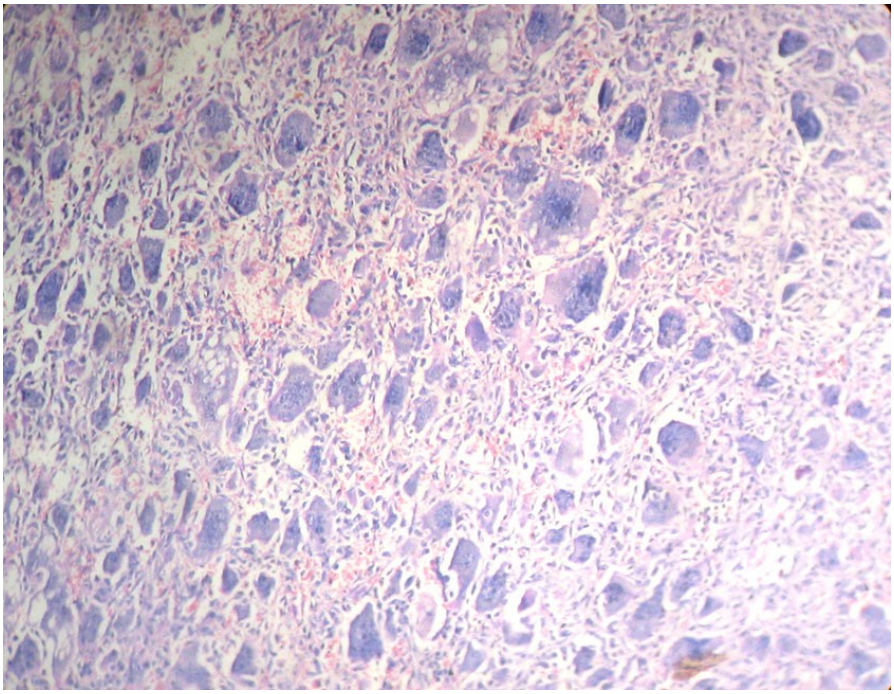


Fig: 20 :- Giant cell tumour showing uniform distribution of osteoclastic giant cells in a background of stromal cells &E (x 100)

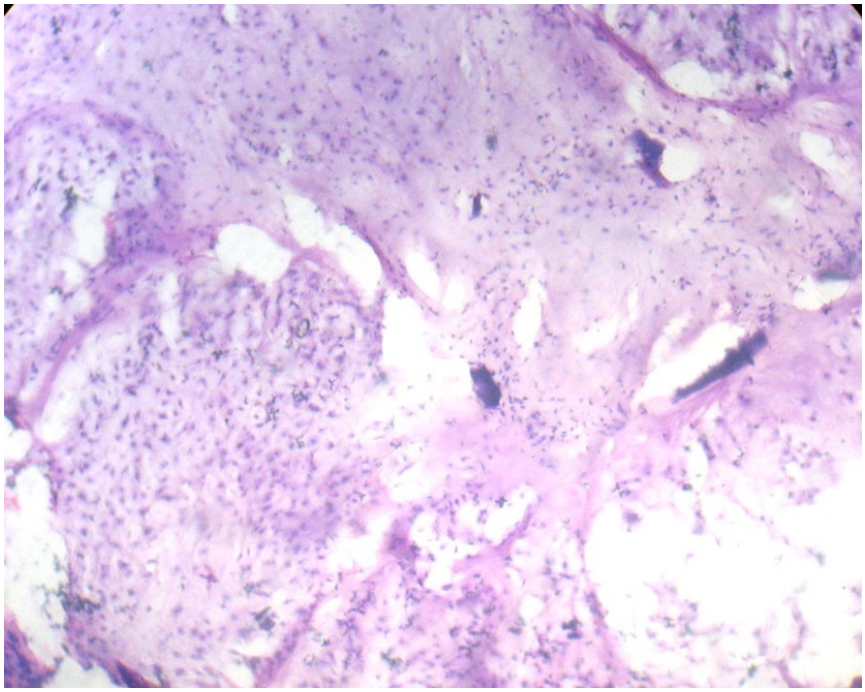


Fig: 21 :- Chondromyxoid fibroma showing lobulated chondroid neoplasm with myxoid and fibroid areas H&E (x 100)

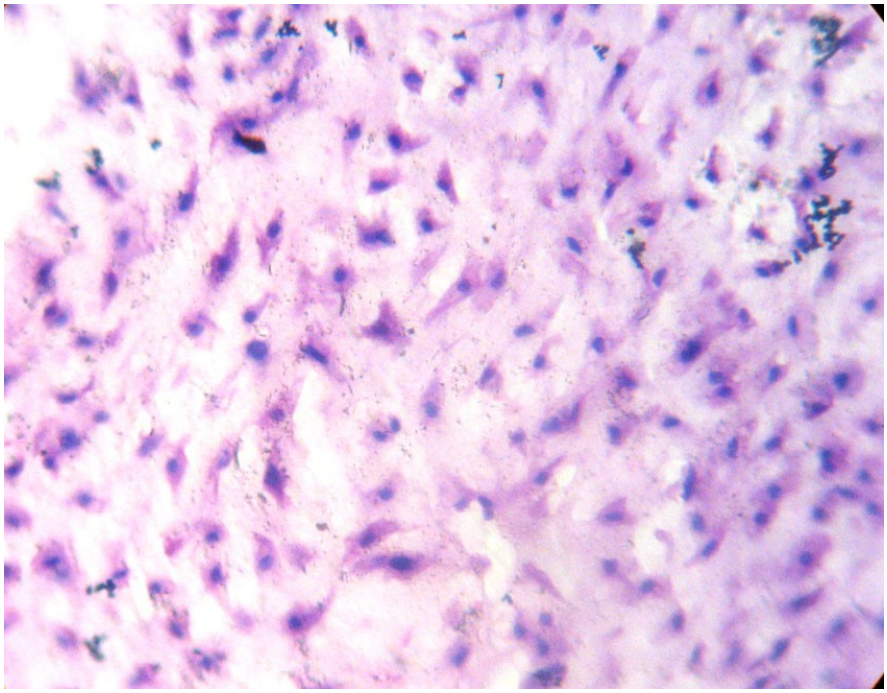


Fig: 22 :- Chondromyxoid fibroma showing stellate cells in myxoid areas H&E (x 400)

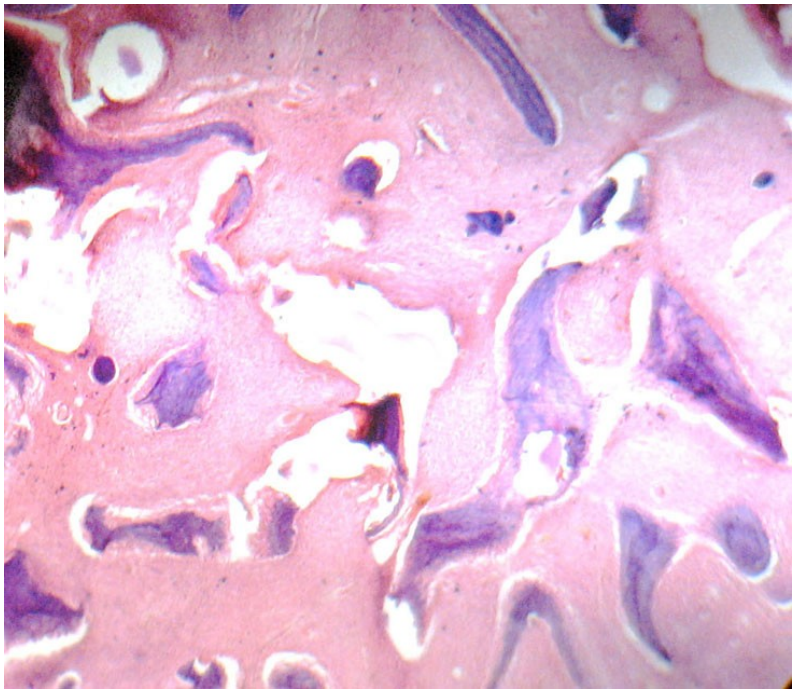


Fig: 23 :- Fibrous dysplasia showing fish hook configuration H&E (x 100)

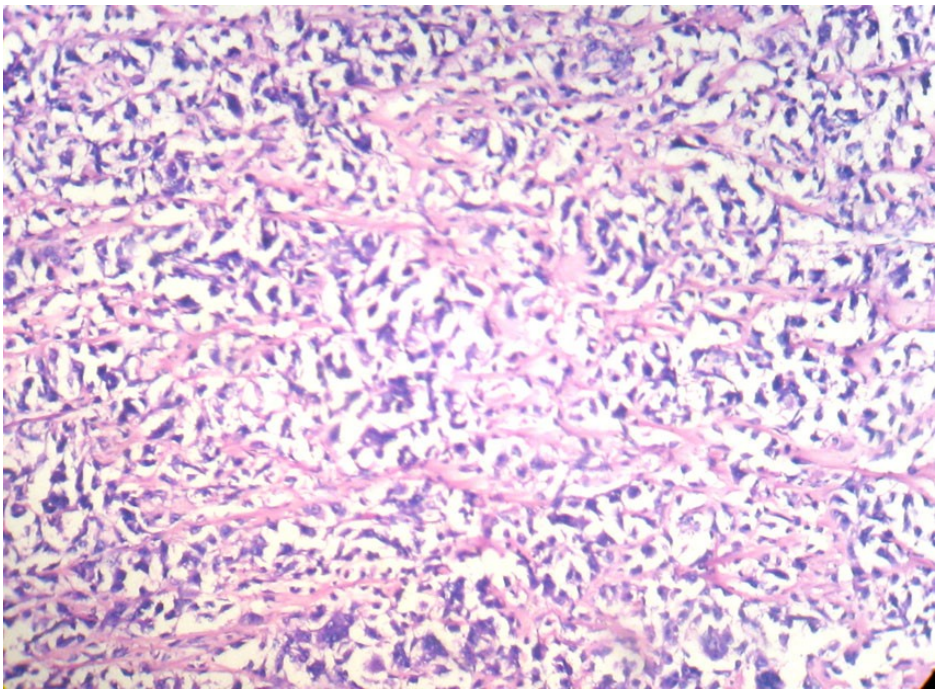


Fig: 24 :- Conventional osteosarcoma showing osteoid produced by the tumour cells H&E (x 100)

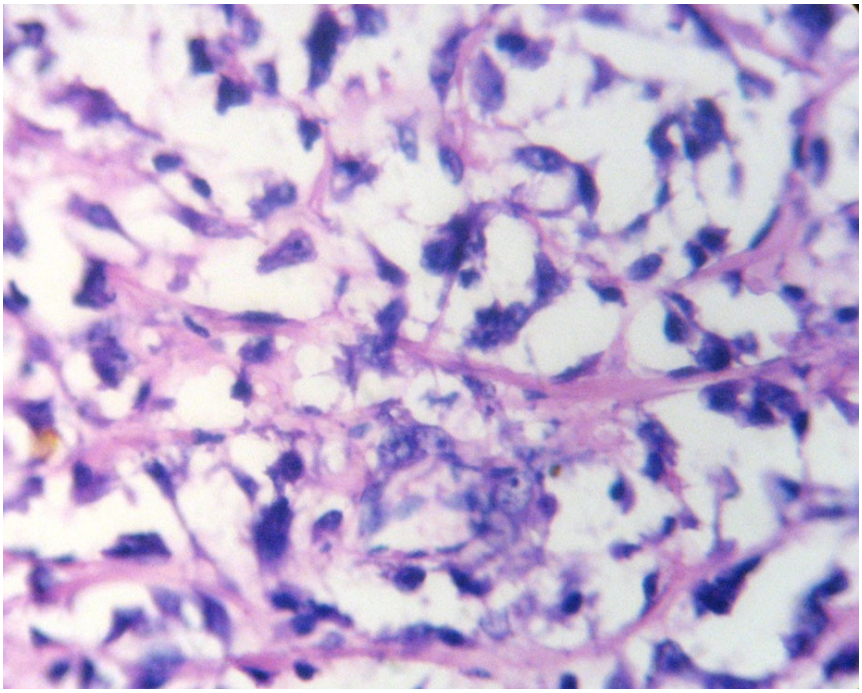


Fig: 25 :- Conventional osteosarcoma showing osteoid [Network of fine lace like trabeculae of bone] H&E (x 400)

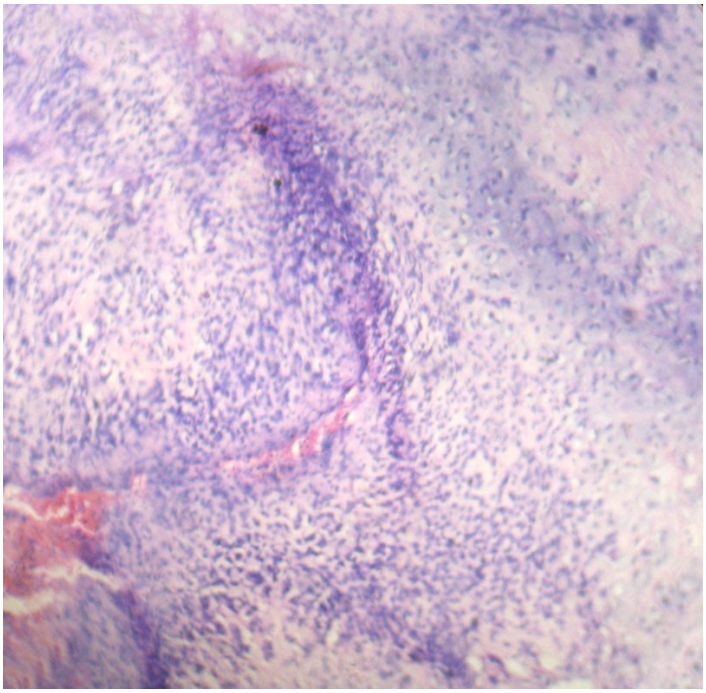


Fig: 26 :- Chondroblastic osteosarcoma showing chondroid areas with malignant spindle cells and osteoid H&E (x 100)

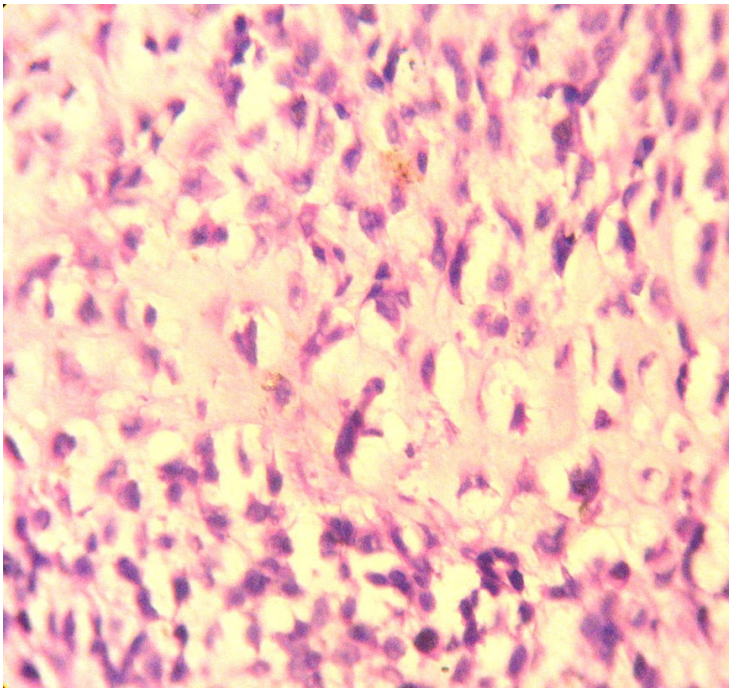


Fig: 27 :- Chondroblastic osteosarcoma showing osteoid H&E (x 400)

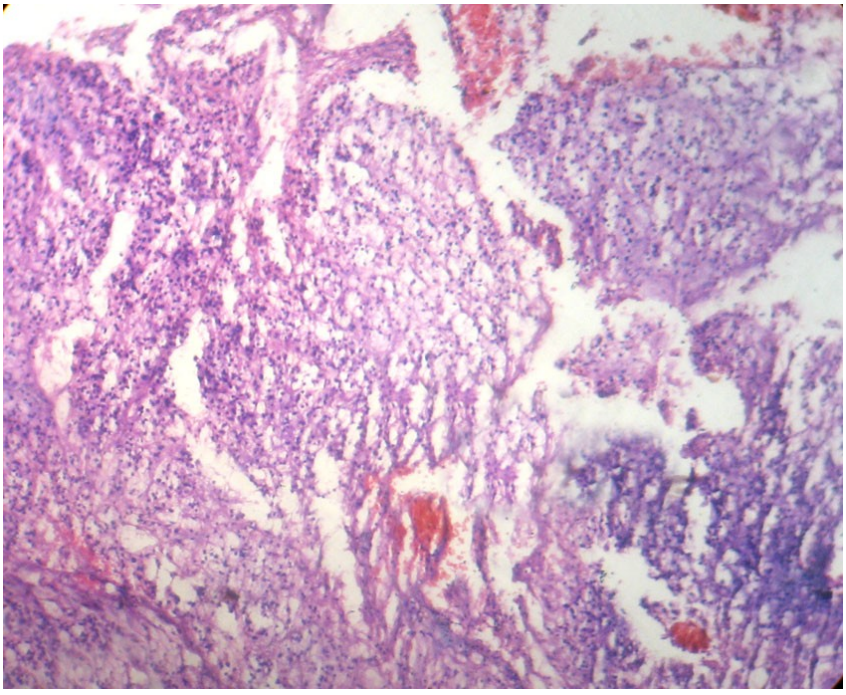


Fig: 28 :- Chordoma showing lobules of tumour cells H&E (x 100)

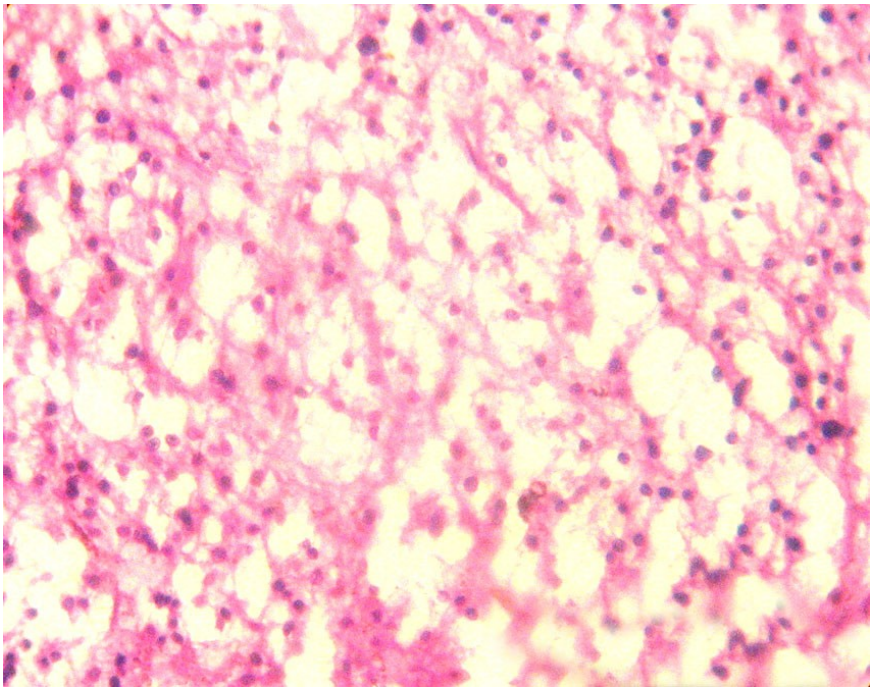


Fig: 29 :- Chordoma - physalliferous cells showing vacuolated cytoplasm H&E (x 400)

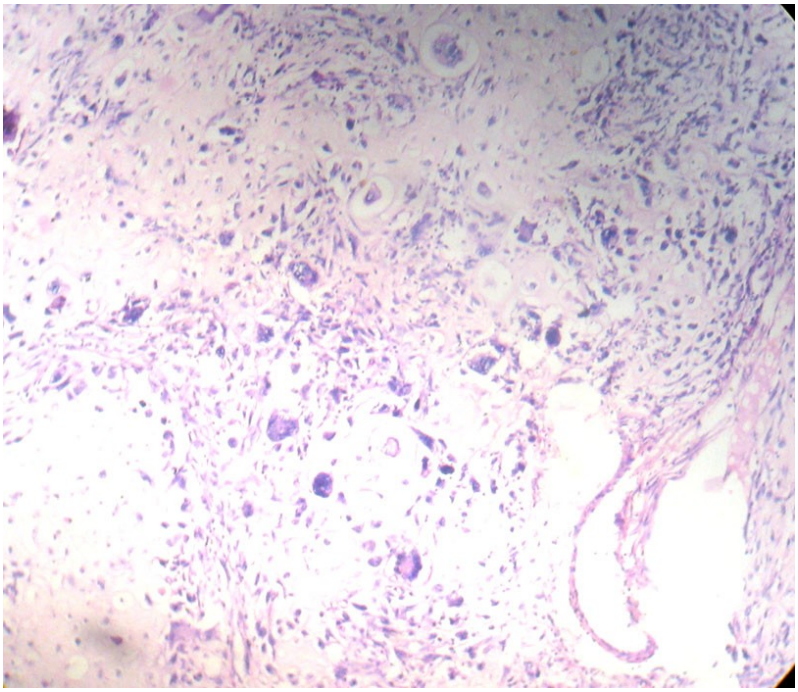


Fig: 30:- High grade osteosarcoma H&E (x 100)

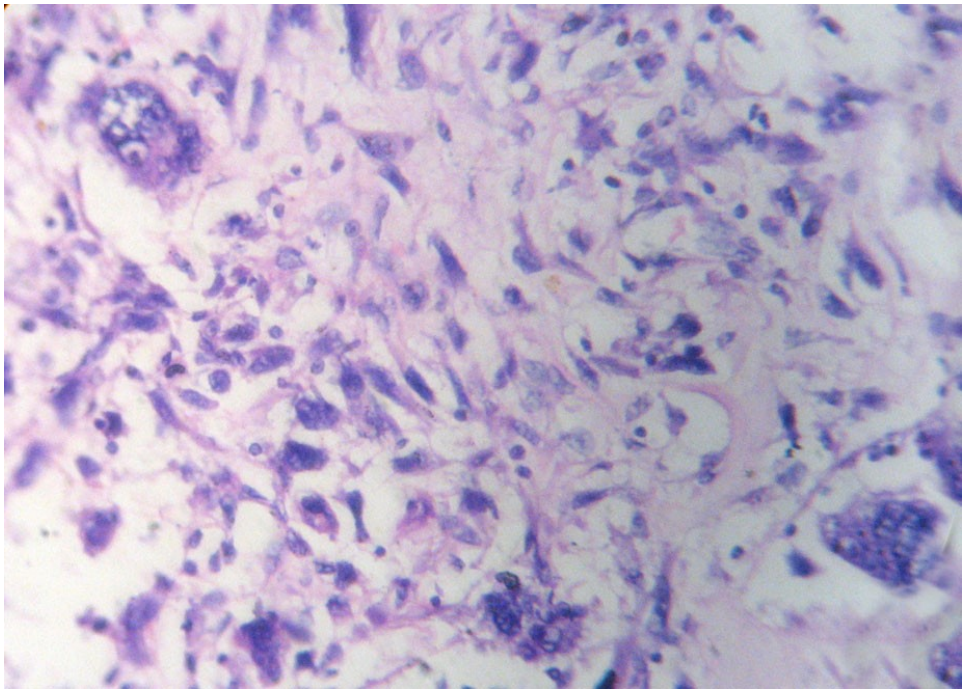


Fig: 31:- High grade osteosarcoma showing pleomorphic and hyperchromatic malignant osteoblast H&E (x 400)

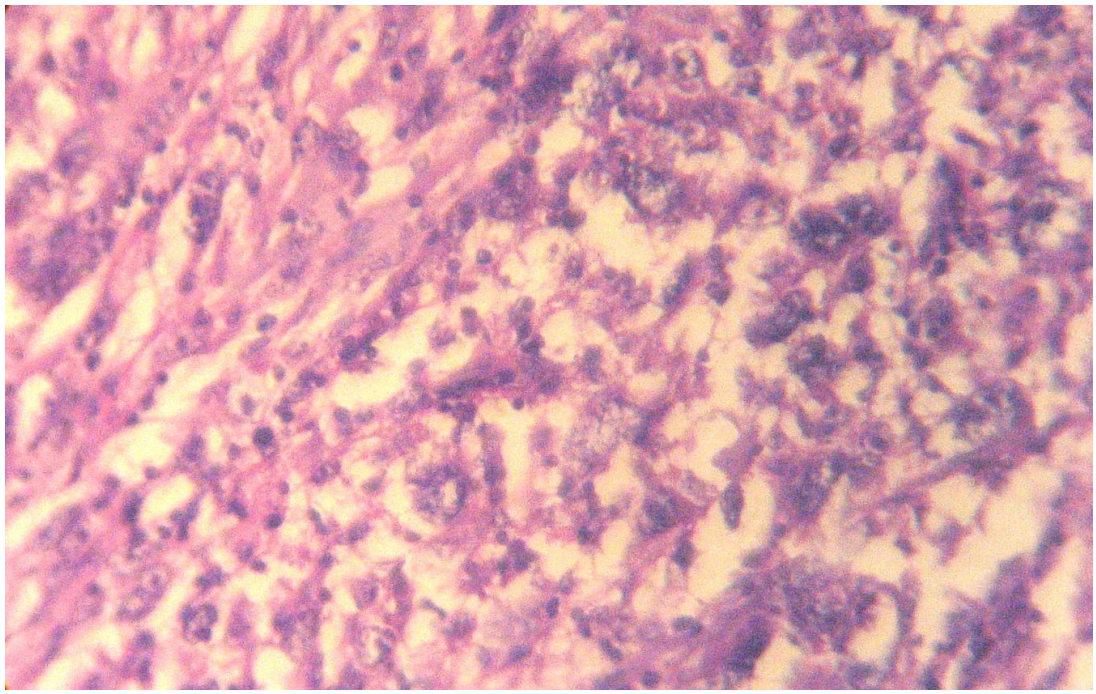


Fig: 32:- Pleomorphic spindle cell sarcoma – Malignant fibrous histiocytoma of bone H&E (x 100)

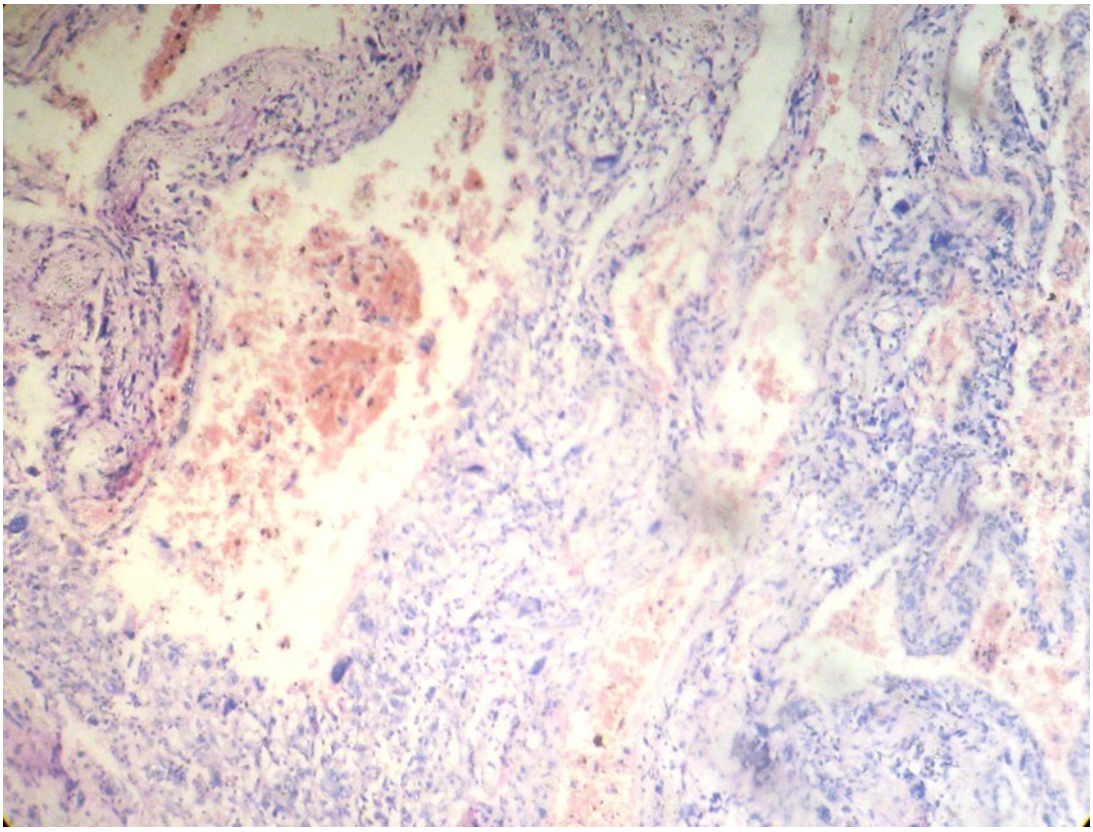


Fig: 33:- Telengiectatic osteosarcoma showing malignant stroma in the septa and blood filled vascular spaces H&E (x 100)

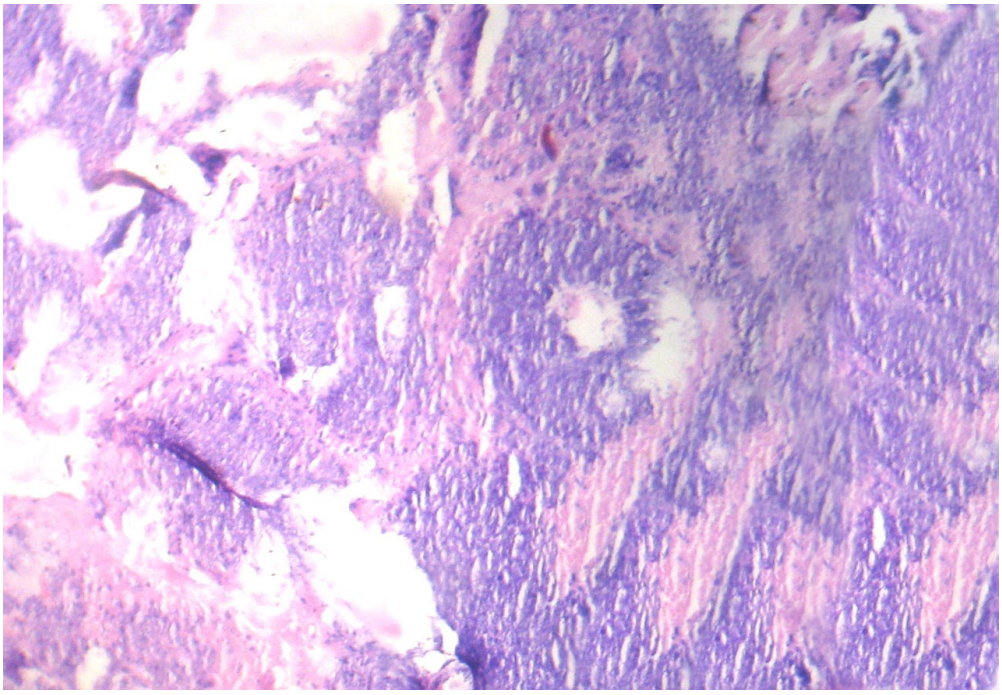


Fig: 34:- Ewings sarcoma showing uniform small round cells with very scanty cytoplasm and Rosette like structures H&E (x 100)

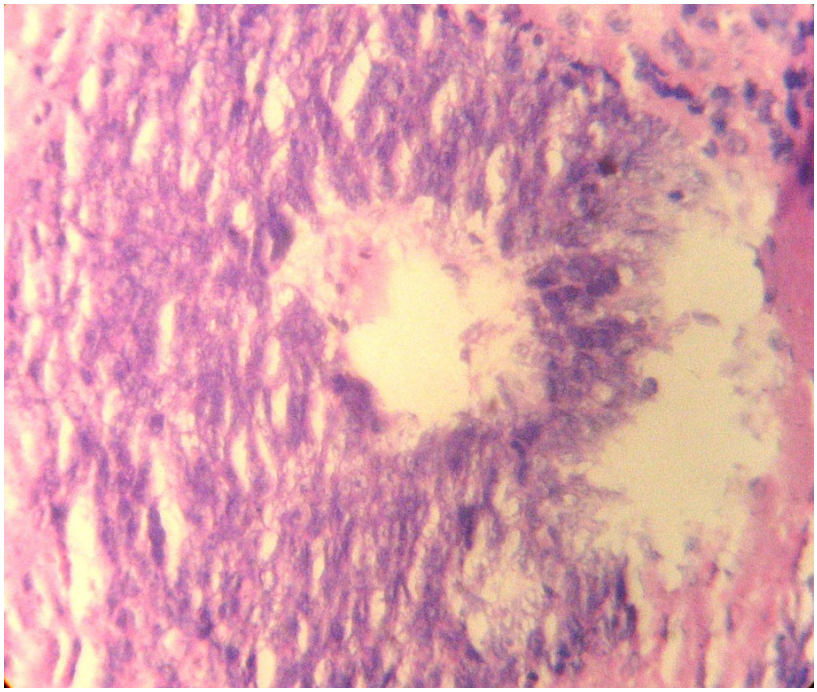


Fig: 35:- Ewings sarcoma - Rosette like arrangement of uniform small round cells H&E (x 400)

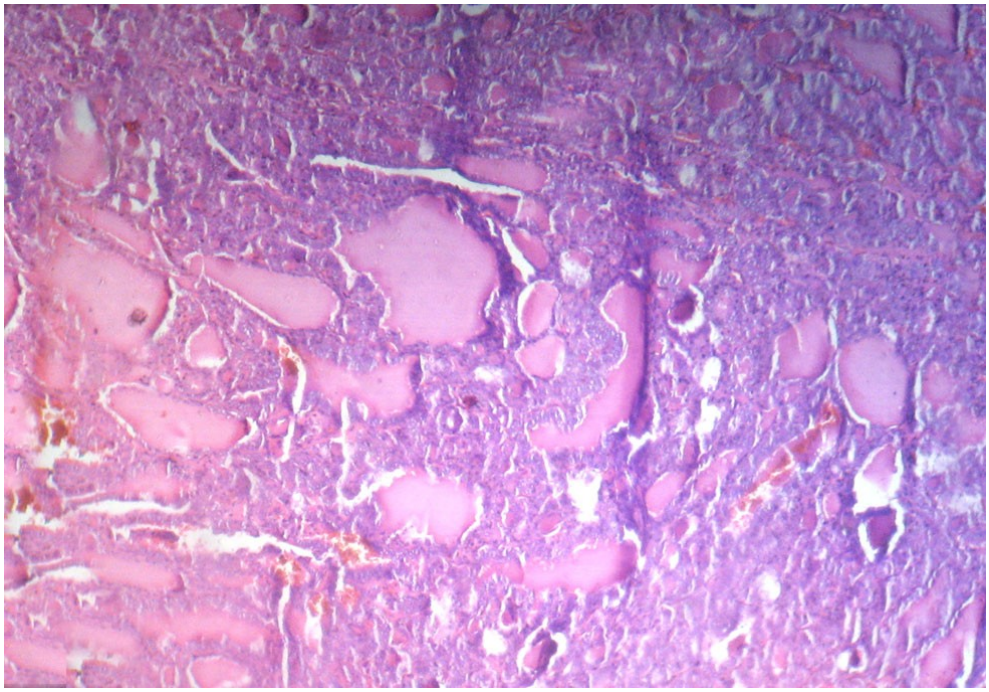


Fig: 36:- Secondary deposits from follicular carcinoma thyroid H&E (x 100)

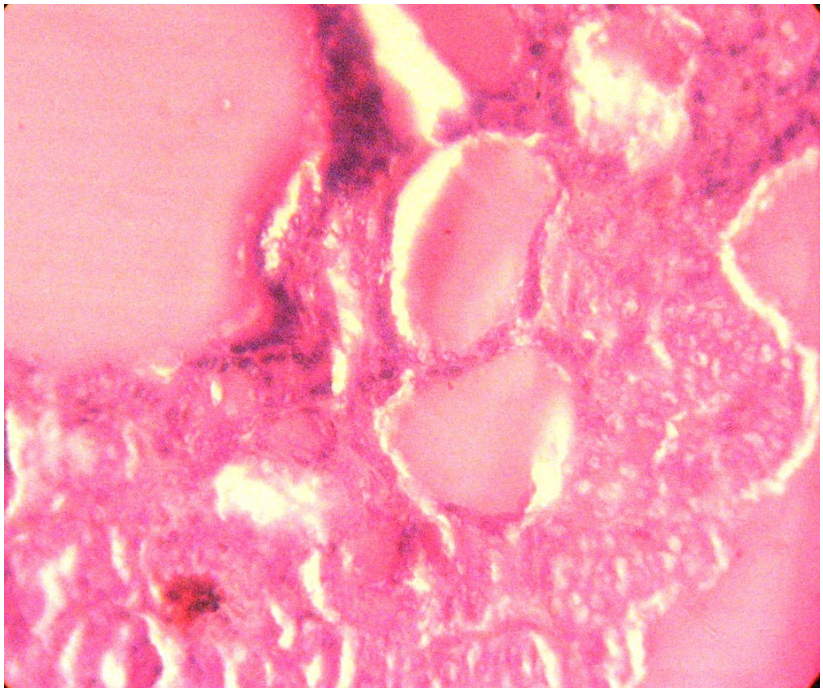


Fig: 37:- Secondary deposits from follicular carcinoma thyroid H&E (x 400)

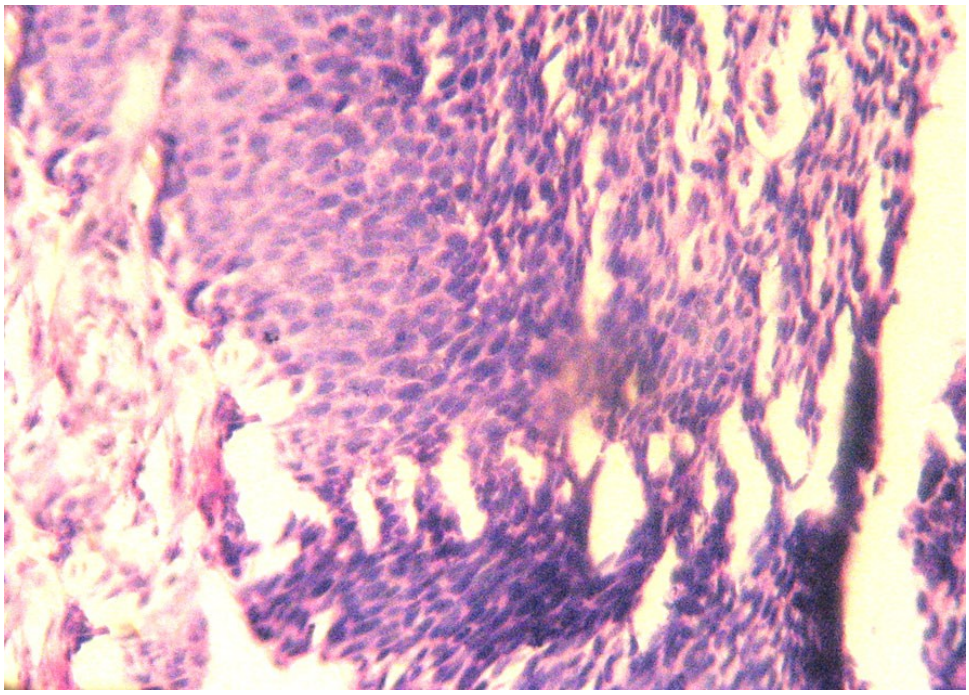


Fig: 38:- Secondary deposits from squamous cell carcinoma cervix H&E (x 400)

CONCLUSION

We evaluate the diagnostic accuracy of FNAC and CNB in a study of 110 cases. Patients with suspected local recurrence of a primary bone tumour and metastasic lesion of a previously diagnosed malignancy were included.

Maximum no of cases (36.4%) were observed in the age group of 11-20 yrs. Of 110 cases in the study, males constituted for 62.8% and females 37.2%. In the present study benign lesions were observed in 44 cases (41.9%) and malignant lesions in 61 cases. In our study, the most common site of lesion are femur (50 cases) and tibia (16 cases). Among the benign lesions, GCT is the commonest one and osteosarcoma is the commonest maliagnant lesion.

We compared the cytological diagnosis with the final diagnosis as assessed by histological examination and clinical, radiological features.

Material considered conclusive for cytological diagnosis was obtained from 67 cases of 110 patients. The biopsy specimen for comparison were available for 47 cases only. The diagnosis was correct in 32 cases (76.2%) of the 42 cases providing adequate cytological material. There were 2 (4.8%) falsely malignant diagnosis.

We compared the core needle biopsy diagnosis as for cytology. CNB was obtained from 30 cases. Resected specimens were obtained for 17 cases. Out of 30 cases, a single core needle biopsy procedure was adequate in 29 cases 96.7% and inadequate in only one case (3%) and the diagnostic accuracy is 76.5%.

Comparative analysis of diagnostic accuracy of FNAC and CNB in present study

Procedure	Adequate tissue %	Diagnostic Accuracy
FNAB	91%	76.2%
CNB	96.7%	76.5%

Our study suggest that FNAC is the most useful technique in diagnosis of bone tumors

1. It is a simple outpatient procedure
2. It gives sufficient cytological materials for the correct diagnosis of cases.
3. FNAC can be effectively used in the screening of various bone lesions and their management.
4. Low cost and lack of complications have made FNA cytology the most preferred and initial test in the evaluation of a mass lesion, compared to CNB.
5. Tumor dissemination is minimal
6. Ancillary methods can be applied

In our study, the main reasons for failure was inadequate sampling rather than diagnostic difficulties. Which can be corrected by repeating the aspirate.

Though open biopsy has 100% accuracy in the diagnosis of malignant bone tumurs, FNAC is the best method of pre operative evaluation to arrive at a definitive diagnosis, because open biopsy involves hospitalization, traumatizing procedures and tumour dissemination.

PROFORMA

Department of Pathology

MMC, Chennai

Name :

Age : I.P. No. :

Sex : FNAC. No. :

Occupation : CNB No. :

Address : Open biopsy No. :

History : Past History :-

H/o Trauma

H/o drug intake

H/o Radiation

Present history :-

Complaints

Duration

Family History :- Similar C/o

O/E : Bone :-

Site of lesion – Single/ Multiple

Size and Shape

Tenderness

Consistency

Investigations :-

1. Radiological – X-ray :- Lytic/ Sclerotic/ Mixed

   Extension with in bone

   Soft tissue extension

   Peripheral Sclerosis

   Calcification — Spotty / Fluffy

   Chicken Wire

MRI/ CT

2. Serological – Sr. alkaline phosphatase
3. FNAC
4. Core needle biopsy
5. Open biopsy

Histopathological Examination :-

Gross :

Microscopy :

Diagnosis :

Remarks

BIBLIOGRAPHY

1. Christopher D.M. Flatcher. Diagnostic Histopathology of tumors second edition 1541 – 1606, 2005.
2. Steven G. Silverberg. Silver berg's principle and practice of surgical pathology and cytopathology 4th edition 2006 701 – 705.
3. Juan Rosai. Rosai and Ackerman's surgical pathology, Ninth edition 2137 – 2236, 2004.
4. Cotran kumar and Collins. Robbins pathologic basis of disease 7th edition 1273 – 1315, 2004.
5. Kilpatrick and Bommer. Principles of Musculo skeletal tumor diagnosis and management third edition 1986 - 1 – 6.
6. Virginia A white. Osteosarcoma and the Role of FNA – A study of 51 cases cancer 62 : 1238 – 1246, 1988.
7. Luis Alonso Desantds. The value of percutaneous needle biopsy in the management of primary bone tumours. Cancer 43 : 735 – 744, 1979.
8. Andris Kreicbergs. Cytological Diagnosis of bone tumours J Bone Joint Surg (Br) 1996 ; 78 – B ; 258 – 263.
9. Gita Ashok Raj, Arti Bhatia. Fine needle aspiration cytology in the diagnosis of bone tumours. Indian Journal of cancer, Dec, 89 260 – 263
10. Donald Resnick. Diagnosis of bone and Joint disorder 4th edition 2002 425 – 437.
11. Henry L Jaffee. Tumours and Tumorous conditions of the bone and Joints 1st edition 9 – 17.

12. Svante R. Orell. Manual and atlas of FNAC 3rd edition 402 – 403 - 1999.
13. Stacey E. Mills Sternbergs. Diagnostic surgical pathology 4th edition 265 – 268.
14. William P. Thorpe. Prognostic significance of Alkaline phosphatase measurements in patients with osteogenic sarcoma receiving chemo therapy cancer 43 : 2178 – 2171, 1979.
15. James A. Welker D.O. The percutaneous needle biopsy is safe and recommended in the diagnosis of musculoskeletal masses –cancer 2000; 89: 3677–3686.
16. Michael a. Simon. Current concepts Review. Biopsy of muscular skeletal tumours. The journal of Bone and Joint surgery 64 – A, No. 8, 1982 1253 – 1257.
17. Zuher M. Naib. Exfoliative Cytopathology. Third edition 553 – 554, 1985.
18. Fritz schajowicz. Tumours and Tumour like lesions of bone 2nd edition 1 – 17.
19. Vincent J. Vigoritus – orthopaedic pathology (1999) 315 – 385.
20. Grace T. Mckel. Diagnostic cytopathology 2nd edition 2004, 881 – 882.
21. Atkinson Silver Man. FNA of musculoskeletal system – Atlas of difficult diagnosis in cytopathology by. 1st edition 1998, 481 – 482.
22. Rober H. Fitz Gerald JR. Multiple Meta Chronous osteogenic sarcoma. The Journal of Bone and Joint surgery 55 – A, 3, 1973 APRIL 595 – 604.
23. Kyoji okada. Osteosarcoma of Hand. A study of 12 cases cancer 1993; 72 : 719 – 725.

24. David M. Parham. Childhood multifocal osteosarcoma – clinicopathologic and Radiologic correlates cancer 55; 2653 – 2658, 1985.
25. John P. Mahoney. Multifocal osteosarcoma. A case report with Review of literature cancer 44 : 1897 – 1907, 1979.
26. Andrew G. Huvos. Telangiectalit osteogenic sarcoma ; A clinico pathologic study of 124 patients cancer 49 : 1679 – 1689, 1982.
27. Micheal Rock. Chondromyxoid fibroma – The experience at the institute orthopedico Rizzoli. The Journal of bone and Joint surgery 65 – A, No. 2, 1983 Feb 198 – 203.
28. K. Krishnan Unni. High grade surface osteosarcoma – study of 46 cases. Cancer 1999; 85 : 10444 – 1054.
29. F. Schajowicz. Osteosarcomas arising on the surfaces of long bones. The journal of bone and Joint surgery 70 – A, 4, 1988. APRIL 555 – 563.
30. Kyoji Okada. Parosteal osteosarcoma – A clinicopathological study. The Journal of bone and joint surgery – 76 – A 3 1994 March.
31. Franco bertoni. Osteosarcoma Resembling osteoblastoma. Cancer 55; 416 – 426, 1985.
32. Herbert H. Stark. Parasteal osteogenic Sarcoma of a metacarpal bone. The journal of bone and joint surgery 53 – A, 1, 1971 – Jan 047 – 153.
33. Franklin H. Sim. Osteosarcoma with small cells simulating Ewings tumour. The journal of bone and joint surgery 61 – A, 2, 1979 – March.
34. Grace T. McKee Diagnostic cytopathology 2004 918 – 928 2nd edition.
35. David C. Dahlin. Bone tumours 1st edition 3 – 7, 1974.

36. William F. Enneking. The issue of the biopsy. The journal of bone and joint surgery 64 – A, 8, 1982 October 1119 – 1120.
37. Henry J. Mankin. The hazards of biopsy in patients with malignant primary bone and soft tissue tumours. The journal of bone and joint surgery 64 – A, 8, 1982 October, 1121 – 1127
38. Henry J. Mankin. The hazards of biopsy, Revisited for the members of the musculoskeletal Tumour Society. The Journal of bone and joint surgery, 78 – A, 5, 1996 may 655 – 663.
39. Rikard Wedin. Cytological diagnosis of skeletal lesions – FNAB in 110 Tumours. The Journal Bone Joint surgery (Br) 2000; 82 – B, 673 – 678.

MASTER CHART

Sr. No.	Age	Sex	Site	X-ray/ CT/ MRI	FNAC	CNB	Open biopsy
1.	15	F	Lt. Hand	(4^{th}) meta carpal osteolytic	3620/04 → Giant cell tumour	-	4420/ 04 → Giant cell tumour
2.	46	F	Upper 1/3 Femur	Osteolytic lesion with osteosclertic rim	-	4107/04 : Fibrous dysplasia	4574/ 04 : Fibrous dysplasia
3.	26	M	Upper 1/3 Femur	Epiphysis – osteolytic	5694/04 :- GCT	-	6770/ 04 :- GCT
4.	28	F	Lower 1/3 Femur	Epiphysis – osteolytic	5873/04 :- GCT	-	6814/ 04 :- GCT
5.	24	M	Lt Knee	Sclerotic lesion lateral tibial condyle	6425/04 :- GCT Chondroblastoma	-	6425/ 04 :- GCT Chondroblastoma
6.	19	F	Lt distal radius	Osteolytic lesion-distal end of radios	5290/04 :- GCT Chondroblastoma sarcoma	4569/04 :- well Differentiated chrondro sarcoma	6000/ 04 :- Chondroblastoma
7.	17	F	Upper 1/3 tibia (Rt)	Osteolytic :- (Rt) medial condyle of Tibia	2922/04 :- osteo sarcoma	4133/04 :- Aggressive GCT	3269/ 04 :- GCT rich osteo sarcoma/ High grade GCT
8.	22	F	(Rt) distal redius	Osteolytic lesion epiphysis	-	3048/04 :- GCT	3454/ 04 :- GCT
9.	39	F	(Lt) Upper humerus	Osteolytic	4475/04 :- GCT	-	5505/ 04 :- osteo sarcoma
10.	12	M	(Lt) Upper 1/3 thigh	Expansile lesion – Upper 1/3 of femur	5749/ :- Inadequate material	-	7/ 04 :- Peri osteal osteo sarcoma
11.	38	M	(Lt) maxilla	Proliferating mass-(Lt) Nasal cavity	2238/04 :- large cell lymphoma	2404/04 :- Large cell lymphoma/ undifferentiated carcinoma	2374/ 04 :- lymphoma/ undifferentiated carcinoma
12.	18	M	(Lt) thigh	Osteolytic lesion (H) femur – lower lateral aspect periosteal elevation (F)	981/04 :- Inadequate material	1160/04 :- osteo sarcoma	-
13.	20	M	(Lt) Upper tibia	-	1026/04 :- S/o cartilaginous neoplasm	-	1329/ 04 :- Chondroblastic OS

Sr. No.	Age	Sex	Site	X-ray/ CT/ MRI	FNAC	CNB	Open biopsy
14.	18	F	(Rt) Lower femur	Osteolytic lesion – metaphysic and epiphysis	-	6849/04 :- GCT	7103/ 04 :- GCT
15.	17	M	(Rt) Upper thigh	Osteolytic lesion – Epiphysis femur	415/04 :- GCT	499/04 :- GCT	6881/ 04 :- GCT
16.	65	M	(Rt) ileum	Cotton wool appearance	-	-	5886/ 04 :- osteo sarcoma
17.	56	M	Lumbar region L1	? Carries spice ? Secondaries	-	2993/04 :- Follicular Ca deposit	-
18.	11	M	(Rt) Upper Leg	Osteoslerotic	-	-	1599/ 04 :- Chondroblastoma osteo sarcoma
19.	70	M	(Rt) lower 1/3 femur	-	-	-	991/04 :- osteochondoma
20.	38	M	(Lt) Needle of femur	Osteolytic	-	-	1286/ 04 :- osteoblastic osteo sarcoma
21.	65	M	(Rt) Knee	-	325/05 :- GCT	-	3041/ 05 :- GCT
22.	53	F	(Lt) foot	-	2520/ 05 :- Synovial sarcoma	-	2220/ 05 :- ABC with focal GCT transformation
23.	25	M	(Lt) humerius	Mixed osteolytic and osteoblastic	3477/ 05 :- Small round cell tumor P/o. Ewings	2843/ 05 :- Small round cell	-
24.	60	F	Pelvis	Expansile osteolytic	1403/ 06 :- Chrondoma	1173/ 06 :- Inadequate	-
25.	35	F	(Rt) elbow	Osteolytic	6502/ 04 :- GCT	-	71/ 05 :- GCT
26.	72	F	(Lt) tibia	Osteolytic	5922/ 05 :- Plenty of plasma cells with few lymphocytes	-	4951/ 05 :- MFH
27.	57	M	Sterium	-	957/ 05 :- Secondary adeno ca deposits	-	1518/ 05 :- secondary metastatic deposits – poorly differentiated ca
28.	25	M	(Lt) femur	Osteolytic	Benign cartilaginous tumour	5979/ 05 :- Chondrama	1197/ 06 :- Chondro Sarcoma
29.	46	F	Upper 1/3 femur	Osteolytic	1358/ 06 :- Osteo Sarcoma	-	2106/ 06 :- GCT with secondary ABC changes
30.	24	M	(Rt) Radius	Osteolytoc lesion	6612/ 06 :- GCT	1076/ 06 :- GCT	1420/ 06 :- GCT
31.	55	F	(Rt) Upper thigh	Secondary deposits	6368/ 05 :- Metastatic deposit from thyroid	-	5321/ 05 :- Metastatic deposits from thyroid

Sr. No.	Age	Sex	Site	X-ray/ CT/ MRI	FNAC	CNB	Open biopsy
32.	17	M	(Rt) humerous	Osteolytic and new bone formation	-	1383/ 06 :- Osteo Sarcoma	1762/ 06 :- osteo sarcoma
33.	39	M	(Lt) ischium	Osteolytic	6923/ 05 :- GCT rich MFH	5833/ 05 :- MFH – Giant cell variant	-
34.	76	M	(Rt) humerous	Osteolytic	-	5967/ 05 :- positive for malignancy	-
35.	45	M	(Lt) femur	Osteolytic and speck eld calcification	5433/ 05 :- chondro sarcoma	-	5263/ 05 :- Malignant chondrogenic tumours
36.	27	M	(Lt) tibia	Osteolytic	575/ 05 :- GCT	-	1136/ 05 :- GCT
37.	18	M	(Lt) distal femur	Cortical destruction and periosteal reaction	-	-	183/ 05 :- Osteo Sarcoma
38.	21	M	(Rt) tibia	Osteolytic	7810/ 05 :- Osteo Sarcoma	-	125/ 06 :- Osteo Sarcoma Telengiectatic variant
39.	20	F	(Rt) ileum	Osteolytic	8142/ 05 :- Sarcoma of osteoblastic origin	6742/ 05 :- Dedifferentiated chondro sarcoma	338/ 06 dedifferentiated chondro sarcoma
40.	20	M	(Lt) distal femur	Osteolytic lesion and cortical destruction	6826/ 05 :- Osteo Sarcoma	1160/ 04 :- osteosarcoma – osteoclastic type	-
41.	60	F	(Lt) thigh	Pathological fracture Neck of femur	6481/ 05 :- Inadequate	1951/ 06 :- Secondary sec deposits	2230/ 06 :- Secondary scc deposits – large cell keratinizing type
42.	25	F	(Lt) Nasal bone	-	-	-	6130/ 05 :- Ossifying fibroma
43.	25	M	(Lt) Upper thigh	Osteolytic	-	-	Chondra Sarcoma
44.	14	M	(Lt) Upper femur	Osteolytic	-	-	6210/ 05 :- Ossifying fibroma
45.	35	F	(Lt) metatarsal	Expansile osteolytic	-	-	6519/ 05 :- GCT
46.	17	M	(Rt) lower thigth	Osteolytic lesion with cortical destruction	-	-	6795/ 05 :- chondroblastic osteo sarcoma
47.	60	M	Lumber vertebrae - L1	Lytic lesion	-	-	-
48.	29	F	(Rt) lower thigh	Thinned out cortex	-	-	6985/ 05 :- GCT
49.	18	M	(Rt) iliac bone	Osteolytic lesion	7995/ 05 :- small round cell tumour	-	-

Sr. No.	Age	Sex	Site	X-ray/ CT/ MRI	FNAC	CNB	Open biopsy
50.	26	M	(R) upper tibia	Fracture medial condyle	649/ 06 :- Hemarrhagic Smear	-	775/ 06 :- Schwanomma / Low grade MPNST
51.	78	F	(Rt) Upper femur	-	504/ 06 :- inadequate material	-	893/ 06 :- Telengiectatic variant of steosarcoma
52.	29	F	(Lt) Scapula	Osteolytic	854/ 06 :- CMF	1071/ 06 :- Chondro myxoid fibroma	-
53.	21	M	Lower 1/3 (Rt) thigh	Solitary osteo chondroma	1566/ 06 :- osteochondroma	1634/ 06 :- osteochondroma	2186/ 06 :- osteochondroma
54.	50	F	(Rt) Radius	Mixed type of lesion	1765/ 06 :- chondro sarcoma	-	2331/ 06 :- Low grade chondro sarcoma
55.	50	F	(Rt) femur	Subtrochanteric fracture	6862/ 05 :- chondro sarcoma	1747/ 06 :- Occasional clusters of hyperchromatic epithelial cells	1990/ 06 :- Adeno carcinomatous deposits
56.	55	F	(Lt) lower hmerous	Osteolytic lesion	3683/ 06 :- Chrondro sarcoma – grade II	-	3654/ 2000 :- chondro sarcoma
57.	24	M	Rt upper tibia	Osteolytic lesion and pathological fracture	2480/ 06 :- Smear is positive for malignancy	2731/ 06 :- osteo sarcoma	-
58.	12	M	(Rt) Scapula	Osteolytic lesion	168/ 05 :- Small round cell tumour	222/ 06 :- Round cell tumour P/o. Ewings	-
59.	14	F	(Lt) distal femur	Exostosis	3110/ 06 :- Benign lesion	-	3929/ 06 :- osteochondroma
60.	30	F	Lumber vertebrae L_1, L_2, L_3,	Destructive changes	3681/ 06 :- Keratinizing SCC deposits	Secondary Ca deposits from poorly differentiated carcinoma	-
61.	42	F	(Rt) tibia	Osteolytic lesion with cortical destruction	2802/ 06 :- GCT rich osteosarcoma	Pleomorphic spindle cell sarcoma in the nature of MFH	4237/ 06 :- Pleomorphic spindle cell sarcoma in the nature of MFH
62.	31	F	(Rt) foot	-	3595/ 06 :- Extra skeletal Ewings sarcoma	-	3274/ 06 :- Round cell tumour P/o : Ewings

Sr. No.	Age	Sex	Site	X-ray/ CT/ MRI	FNAC	CNB	Open biopsy
63.	20	F	(Rt) distal radius	Osteolytic lesion	2786/ 06 :- GCT	-	3507/ 06 :- GCT
64.	35	F	(Rt) distal femur	Osteolytic lesion	3815/ 06 :- Non ossifying fibroma	-	3785/ 06 :- Benign fibrous lesion
65.	18	F	(Rt) Second metatarsal bone	-	? Fibroma	-	4067/ 06 :- Neurofibroma
66.	12	F	(Lt) Proximal tibia	-	4269/ 06 :- Ewings sarcoma	-	4100/ 06 :- Fibroblastic osteosarcoma
67.	45	F	(Lt) Proximal femur	-	-	1170/ 06 :- Anurysmal bony cyst.	1950/ 06 :- Osteitis fibrsa cytica
68.	23	F	(Lt) distal femur	Osteolytic lesion	3854/ 06 :- Osteo chondroma	-	-
69.	15	F	(Lt) knee	Mixed sclerotic and lytic lesion-Tibia	3869/ 06 :- Osteo Sarcoma	-	4440/ 06 :- High grade osteosarcoma.
70.	22	M	(Rt) leg	Osteolytic lesion – Middle 1/3 of Tibia ? Osteosarcoma ? Ewings sarcoma	3981/ 06 :- Ewings Sarcoma	-	-
71.	58	M	(Rt) leg	Osteolytic lesion upper 1/3 tibia	4133/ 06 :- smear is positive for malignancy	-	-
72.	38	M	(Rt) ring finger	Osteolytic	4381/ 06 :- GCT	-	-
73.	46	F		Osteolytic lesion 3, 4, 5 ribs	4454/ 06 :- Lympho proliferative disorder	-	-
74.	44	M	Rt thigh	Osteolytic lesion with irregular cortex	5028/ 06:- chondro sarcoma	-	-
75.	27	F	(Lt) 5th meta carpal	-	3574/ 06 :- chondroma	-	-

Sr. No.	Age	Sex	Site	X-ray/ CT/ MRI	FNAC	CNB	Open biopsy
76.	59	M	Para vertebral region	(1) Chondro Sarcoma (2) Extra osseous Soft tissue osteasarcoma	3500/ 06 :- Papillary adeno carcinomatous deposit	-	-
77.	50	F	Ileum	Osteolytic	-	200/ 06 :- chondrosarcoma	1002/ 06 :- chondrosarcoma – Gr II
78.	15	M	(Lt) distal femur	Diaphysis : osteolytic lesion with soft tissue component	749/ 06 :- organizing hematoma	3657/ 06 :- Peri osteal osteosarcoma	-
79.	75	M	(Rt) Maxilla	-	-	-	Squamous cell carcinoma
80.	22	F	(Rt) Mid 1/3 femur	Destructive lesion with fracture shaft of femur	-	3039/ 06:- spindle cell sarcoma (1) synovial sarcoma (2) MPNST	2288/ 06 :- spindle cell sarcoma (1) synovial sarcoma (2) MFH
81.	10	M	(Rt) proximal Tibia	Diffuse periosteal osteosclerotic lesion	-	-	2414/ 06 :- High grade osteo sarcoma
82.	53	F	(Lt)distal femur	Eccentric osteolytic lesion	-	-	2561/ 06 :- GCT
83.	36	M	(Rt) distal radius	Expansile lytic lesion	-	-	2607/ 06 :- High grade GCT
84.	18	F	(Rt) distal femur	Expansile lytic lesion	-	-	2984/ 06 : GCT
85.	16	M	(Lt) femur	Exostosis	-	-	3011/ 06 :- osteochondroma
86.	30	M	(Lt) femur	Exostosis	-	-	3037/ 06 :- osteochondroma
87.	32	F	(Rt) lower end of radius	Osteolytic lesion	4270/ 06 :- GCT	-	-
88.	26	M	(Rt) distal femur	Osteolytic lesion – metaphysic	-	-	3282/ 06 :- osteasarcoma – osteoclastic type
89.	11	M	(Rt) distal femur	? Ewings sarcoma	-	-	3492/ 06 :- exostosis
90.	40	F	L4 – L5	? Carries spine	-	-	3530/ 06 :- chondroma
91.	20	M	(Rt) distal humerous	Osteoblastic lesion with Peri osteal elevation	-	-	3574/ 06 :- Chondroblastic osteosarcoma
92.	15	M	(Lt) femur	-	-	-	3657/ 06 :- High grade osteosarcoma- Chondroblastic type
93.	14	M	(Lt) femur	Exostosis	-	-	3669/ 06 :- Osteochondroma

Sr. No.	Age	Sex	Site	X-ray/ CT/ MRI	FNAC	CNB	Open biopsy
94.	35	M	(Lt) femur	Exostosis	-	-	3709/ 06 :- Osteochondroma
95.	14	M	(Rt) humerous	Exostosis	-	-	3723/ 06 :- Osteochondroma
96.	49	M	Pelvis	Osteolytic lesion	-	-	3885/ 06 :- chondroma
97.	47	F	Rt ileum	? ABC ? GCT	-	-	4018/ 06 :- Neurogenic tumour/ muloid liporatous tumour
98.	20	M	Rt femur	Supra condylar fracture	-	-	2432/ 06 :- Chondroblastic
99.	35	M	Lt femur	Osteoblastic lesion	-	3223/ 06 :- Chondro myxoid fibroma	4259/ 06 :- Osteosarcoma
100.	20	M	? Clival chondroma	? control destructive lesion in central skull base	-	-	2618/ 06 :- GCT
101.	20	M	Parietal bone	Lytic lesion	-	-	2623/ 06 :- Fibrous dysplasia
102.	18	M	(Lt) lower femur	Osteolytic lesion	5235/ 06 :- inadequate material	-	-
103.	40	M	(L) upper humerous	Osteolytic lesion	5259/ 06 :- plasmacytomea	-	-
104.	17	M	(Lt) proximal fibular	Osteolytic lesion	5283/ 06 :- Small cell osteosarcoma	-	-
105.	37	M	(Lt) femur	Lytic lesion- Metaphyseo epiphyseal	4743/ 06 :- Inadequate material	-	4442/ 06 :- Desmoplastic fibroma
106.	11	F	Rt distal femur	Diffuse osteolytic/ osteoblastic lesion	-	-	4306/ 05 :- osteosarcoma
107.	33	F	(Lt) proximal femur	Osteolytic lesion with cortical destruction	-	-	4858/ 05 :- wall differentiated chondro sarcoma
108.	19	M	(Rt) ank;e calcanium	Sclerotic lesion	4275/ 06 :- Malignant chondroid neoplasm	-	5160/ 06 :- Chondroblastic variant of Osteosarcoma
109.	05	M	(Lt) distal femur	Lytic lesion with periosteal elevation	5655/ 06 :- Ewings sarcoma	-	5233/ 06 :- chronic non specific osteomylitis
110.	54	F	(Lt) leg	Erosion (+) Tibial mataphysis	5224/ 06 :- chondrosarcoma	-	-